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KOREA RESEARCH INSTITUTE OF BIOSCIENCE AND BIOTECHNOLOGY 2010 ANNUAL REPORT KRIBB

KOREA RESEARCH INSTITUTE
OF BIOSCIENCE AND BIOTECHNOLOGY

2010
ANNUAL REPORT

KRIBB

CONTENTS

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 for Koreans all over. Our goal is to shape a brighter, better and healthier future for all, in Korea and around the world.

MISSION & VISION

MISSION

To carry out research and development activities and related projects in the field of bioscience and biotechnology in joint effort with other research institutes, academic bodies, and businesses at home and abroad and 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	Providing Solutions to National Agenda	Establishing World-class Research Infrastructure
Five World-class Generic Technologies	Three Internationally Competitive R&D bases	World's Top Five Biotechnology Research Infrastructure

Future Bio-convergence | Personalized Bio-Medicine | Bio Green Technology | Bio-based National Agenda | Bio Research Infrastructure

MAJOR OBJECTIVE

CORE DIRECTIONS FOR RESEARCH & BUSINESS PROJECTS

▸ 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 generic 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 R&D 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 data and facility infrastructure

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 generic technologies in bioscience and biotechnology

- Future bio-convergence, personalized bio-medicine, bio green technology, bio-based national agenda

Public infrastructure development support for research on bioscience at home and abroad

- Public infrastructure development support, 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 & 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

HUMAN RESOURCES

Descriptions	Executives	Researchers	Engineers	Administrators	Technicians	Total
Regular employees	1	208	52	32	46	338

BUDGET (Unit : Millions of Won)

Revenue

Descriptions	
Government funds	56,675
Institute revenues	57,872
Government-funded projects	51,138
Privately-funded projects	2,334
Other research projects	600
Technology supports	1,200
Royalties	1,200
Others	1,400
Total	114,547

Expenditure

Descriptions	
Personal expenses	24,516
Direct research expenses	72,961
Major projects	29,283
Government-funded projects	40,454
Privately-funded projects	1,724
Other research projects	600
Technology supports	900
General and administrative expenses	6,110
Facility expenses	9,348
Others	1,612
Total	114,547

FACILITIES (Unit : m^2)

Daejeon Headquarters

Site	100,978
Building	53,448
Main Building	11,871
Research Building	17,008
Resource Building	6,554
Venture Building	3,044
Native plant Building(1)	1,134
Native plant Building(2)	1,077
Cafeteria Building	2,646
Green house research building, etc.	1,765
Residence	6,879
Apartment	1,900
Dormitory	4,979

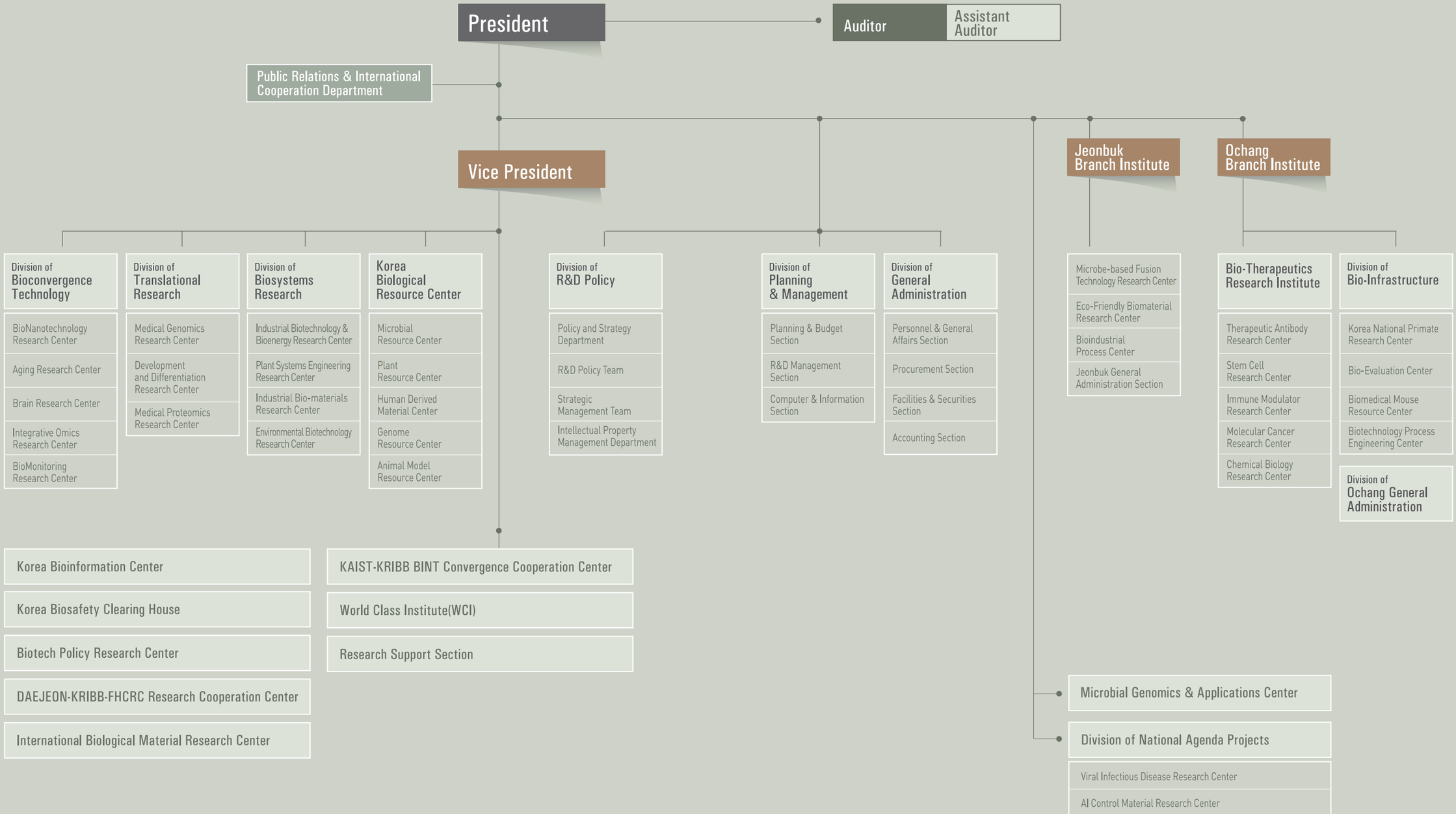
Ochang Branch Institute

Site	212,258
Building	26,548
Research	26,548
National Primates Research Center	4,774
Bio-Evaluation Center	9,636
Biotherapeutic Research Center	11,558
Others	580

Jeonbuk Branch Institute

Site	18,522
Research Building	6,125
Administrative building and Dormitory	2,811

ORGANIZATION



YEARLY PROGRESS

PERSONNEL

	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010
Regular Employees	243	280	290	300	297	295	294	293	314	338
Nonregular Employees	343	353	461	510	547	530	639	657	650	747
Total	586	633	751	810	844	825	934	950	966	1,085

BUDGET

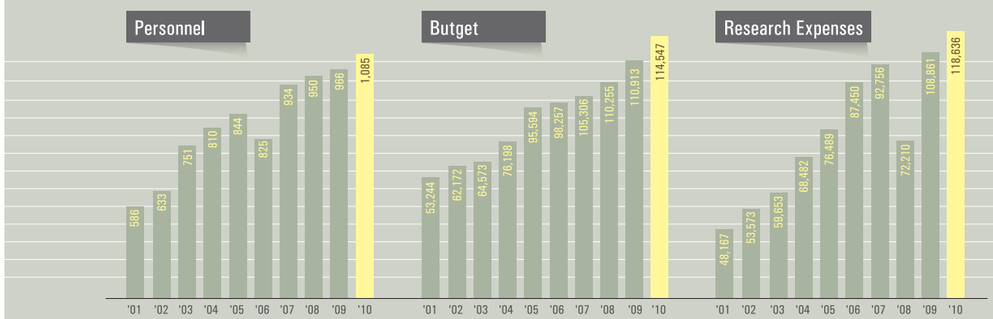
Unit : Millions of won

	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010
Total	53,244	62,172	64,573	76,198	95,594	98,257	105,306	110,255	110,913	114,547

RESEARCH EXPENSES

Unit : Millions of won

	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010
Government	37,525	43,085	37,888	44,008	47,041	50,941	55,245	56,647	63,140	68,978
Institutes	9,580	10,044	20,268	22,860	28,546	35,210	40,669	42,963	43,323	46,915
Private	1,023	444	757	709	702	1,299	1,401	1,487	2,398	2,743
Others	39	-	740	905	200	-	-	-	-	-
Total	48,167	53,573	59,653	68,482	76,489	87,450	92,756	72,210	108,861	118,636



PUBLICATIONS

Unit : Items

	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010
Domestic	115	106	121	119	137	145	182	160	159	130
Overseas	188	170	229	273	302	365	295	375	373	452
Total	303	276	350	392	439	510	477	535	532	582

PATENTS

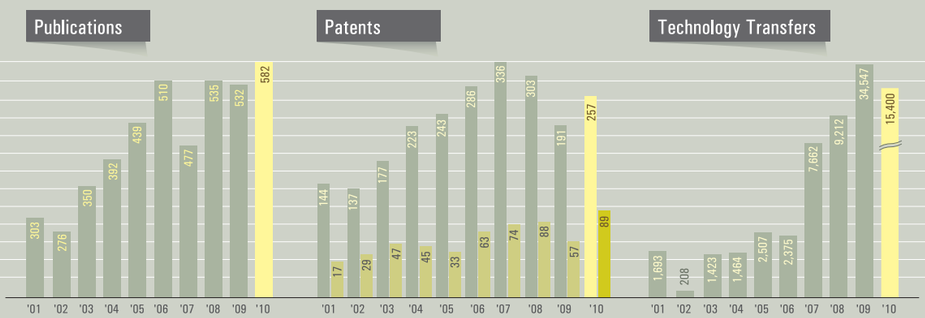
Unit : Items

		2001	2002	2003	2004	2005	2006	2007	2008	2009	2010
Domestic	Application	116	106	121	117	136	141	129	141	130	173
	Registration	65	64	64	88	116	139	142	108	61	84
Overseas	Application	8	12	19	25	23	46	54	70	39	48
	Registration	9	17	28	20	10	17	20	18	18	41

TECHNOLOGY TRANSFERS

Unit : Items, Millions of won

	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010
Domestic	20	2	11	8	15	13	17	17	5	17
Overseas	-	1	-	-	-	-	2	1	1	3
Total	20	3	11	8	15	13	19	18	6	20
Amount	1,693	208	1,423	1,464	2,507	2,375	7,662	9,212	34,547	15,400



Cutting-Edge Research And Industrial Research To Innovations

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At KRIBB, we conduct cutting-edge biotechnology research in areas essential for our society and critical for achieving sustainable economic growth such as public health, food, new biomaterials, the environment and new energy sources. Meanwhile, our basic industrial technology research underpins the development of Korean industry and contributes to the future prosperity of our nation.

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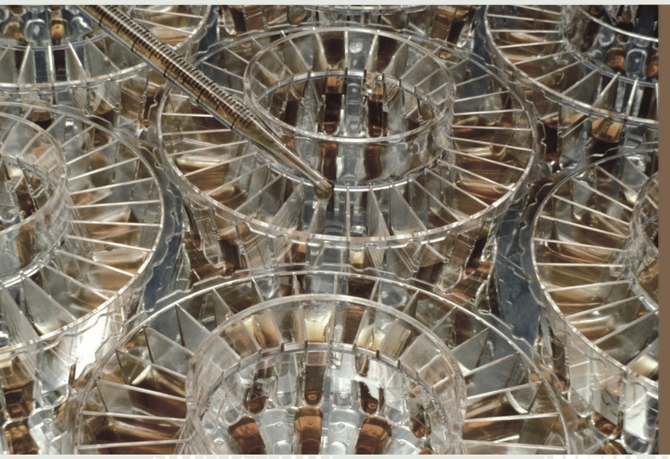
Division of Bioconvergence Technology



BioNanotechnology Research Center
Aging Research Center
Brain Research Center
Integrative Omics Research Center
BioMonitoring Research Center

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A Healthier Future for People the World Over - This is Our Pledge and Promise

Our work in converging technologies to develop new bionanomaterial-based treatments, gerontology research to prolong life and improve the health of senior citizens, brain and neurobiological research and omics technique-enabled biopharmaceutical research helps usher in a healthier society.

BioNanotechnology Research Center

RESEARCHERS

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- Bionanotechnology
- Smart biochips & biomolecular process engineering

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- Biochemistry & immunology

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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

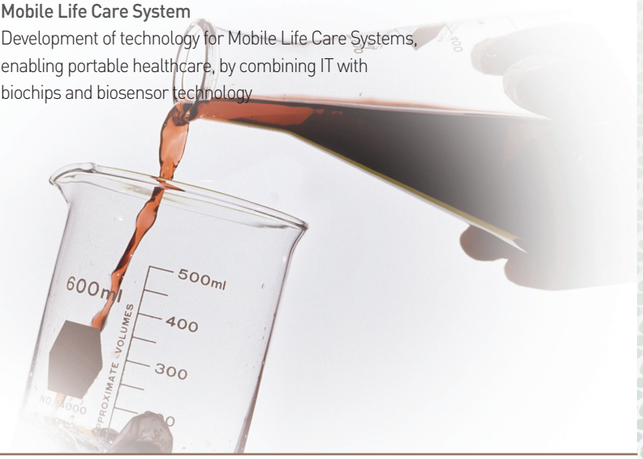
Conjugation of inorganic materials, such as metals and magnetic nano-particles, to various organic molecules in order to investigate the characteristics of proteins and to develop new drugs

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



Our research center is involved in the development of nano-biochips, nano-biosensors 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 contribute to the creation of new businesses and realize our dream of prolonging human life.

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ACHIEVEMENTS

Development of a new palm-sized surface plasmon resonance (SPR) biosensor

A novel surface plasmon resonance (SPR) sensing scheme was devised to develop a palm-sized SPR biosensor device. This provides for a portable POCT SPR sensor device which enables label-free and real-time analyses. This method also eliminates image quality deterioration originating from the coherency of the laser illumination source. The results of a series of tests confirmed the practicality of sensor for the on-site detection of a variety of substances in biology, diagnosis, the environment, and defense.

Perfluorodecalin/[InGaP/ZnS quantum dots] nanoemulsions as 19F MR/optical imaging nanoprobes for the labeling of phagocytic and nonphagocytic immune cells.

We developed the bimodal imaging contrast agent, perfluorodecalin (PFD)/[InGaP/ZnS quantum dots (QDs)] composite nanoemulsions. (19)F molecules in the PFD/[InGaP/ZnS QDs] nanoemulsions provide a (19)F-based MR imaging capability, while fluorescent QDs dispersed in PFD nanodroplets provide an optical imaging modality. These bimodal imaging contrast agents can be delivered easily into both phagocytic and nonphagocytic immune cells. Internalization of multifunctional PFD/[InGaP/ZnS QDs] nanoemulsions into immunotherapeutic cells permits the labeled cells to be imaged by both magnetic resonance and fluorescence imaging with little effect on cell viability and function. The results of our study highlight the potential of PFD/[InGaP/ZnS QDs] nanoemulsion as a bimodal imaging nanoprobe for molecular imaging in immune cell-based cancer therapies.

Fabrication of a structure-specific RNA binder for array detection of label-free microRNA

A novel structure-specific RNA-binding protein was designed to stably and specifically bind to surface-bound microRNAs. By acting like an antibody, this RNA binder enabled the universal detection of hybridized microRNAs on array surfaces (see picture) without any enzymatic amplification or labeling reactions.

SELECTED PUBLICATIONS

Bong Hyun Chung (Corresponding) *Biomaterials*. 31(18):4964-71.
Perfluorodecalin/[InGaP/ZnS quantum dots] nanoemulsions as ^{19}F MR/optical imaging nanoprobes for the labeling of phagocytic and nonphagocytic immune cells

Yongwon Jung (Corresponding) *Angew Chem Int Ed Engl*. 49(46):8662-5.
Fabrication of a structure-specific RNA binder for array detection of label-free microRNA

Bong Hyun Chung (Corresponding) *Chem Commun (Camb)*. 46(19):3315-7.
Label-free and naked eye detection of PNA/DNA hybridization using enhancement of gold nanoparticles

Sang Jeon Chung (Co-corresponding) *Chemistry*. 16(18):5297-300.
An iminocoumarin-based fluorescent probe for the selective detection of dual-specific protein tyrosine phosphatases

Bong Hyun Chung (Corresponding) *J Phys Chem C*. 114(30):12976-81.
Synthesis and characterization of various-shaped C_{60} microcrystals using alcohols as antisolvents

Bong Hyun Chung (Corresponding) *Small*. 6(1):126-31.
Proteolytic fluorescent signal amplification on gold nanoparticles for a highly sensitive and rapid protease assay

Aging Research Center

RESEARCHERS

Kweon Yu kweonyu@kribb.re.kr
- Molecular genetic studies on aging using the *Drosophila* model system
- Neurophysiological studies of neuropeptides using the *Drosophila* model system

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

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

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

Kyu-Sun Lee ekuse74@kribb.re.kr
- Development of *Drosophila* model systems for studying age-related diseases including diabetes and neurodegenerative diseases

Jeong-Soo Lee jeongsoo@kribb.re.kr
- Understanding physiological roles of neuropeptides using *Drosophila* and zebrafish as genetic modelsystems
- Understanding genetic interactions of the tumorigenesis and metabolic processes using zebrafish

RESEARCH AREAS

Bioinformatics/Omics-based research to discover novel molecular targets for anti-aging strategies

Molecular Genetic Research
- Studies on signaling pathways regulating cellular senescence during aging
- Studies on functions of insulin signaling genes and stress-related genes during aging

Animal model research
- Generation of model flies and zebrafish to study the function of genes implicated in aging processes
- Development of mouse models to study the function of age-related genes *in vivo*
- Discovery of target genes for the early detection of aging
- Development of novel candidate drugs to delay aging processes

**We investigate genes and signaling pathways which regulate cellular senescence and aging of model animals.
We also develop animal model systems to study longevity and age-related degenerative disorders.
The ultimate goals of our center are to identify molecular markers for aging processes and to develop pharmaceutical and nutraceutical drugs for healthy aging.**

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ACHIEVEMENTS

Identification of age-related genes in human muscles
Analyses of the genes that are differentially expressed in human muscle tissue as aging proceeds led us to identify (1) upregulated genes that are involved in the stability and maturation of RNA and regulate the activities of various transcription factors, and (2) downregulated genes that are required for NADH production, regulate the activity of diverse types of receptors, and is critical to comprise mitochondrial electron transport chains. We are interested in understanding the function of several novel candidates among these age-related genes by utilizing human dermal fibroblasts and rat muscle tissue. Further research on these age-related markers may provide an insight into the aging process and anti-aging strategies.

sNPF controls lifespan
We have shown that short neuropeptide F (sNPF) signaling regulates lifespan through ERK-mediated insulin signaling in *Drosophila*. Suppression of sNPF signaling in sensory neurons increased the median lifespan by 20% compared to the lifespan of control flies, whereas over-expression of sNPF had no effect.

Animal model research
Prx II maintains the hippocampal synaptic plasticity against age-related oxidative damage. The production of age-dependent mitochondrial ROS and the decline of longterm potentiation (LTP) were more prominent in the hippocampal neurons of Prx II(-/-) than of wild-type mice. In Prx II(-/-) mice, signaling pathways that regulate synaptic plasticity, including pathways of CREB, CaMKII, and ERK, failed to be activated. Furthermore, the functional integrity of mitochondria in these mice was not maintained properly.

SELECTED PUBLICATIONS

Sung Sup Park (Corresponding) *Brain Res.* 1359:291-7.
Extracellular hydrogen peroxide contributes to oxidative glutamate toxicity

Ki Sun Kwon & Sung Sup Park (Co-corresponding) *Exp Cell Res.* 316(10):1651-61.
Nox4-dependent H_2O_2 production contributes to chronic glutamate toxicity in primary cortical neurons

Kweon Yu (Co-corresponding) *FEBS Lett.* 584(16):3609-14.
The *Drosophila* homolog of methionine sulfoxide reductase A extends lifespan and increases nuclear localization of FOXO

Dae Yeul Yu (Co-corresponding) *J Neurochem.*114(1):39-50.
Microglial peroxiredoxin V acts as an inducible anti-inflammatory antioxidant through cooperation with redox signaling cascades

Kyu-Sun Lee (Co-first) *Rejuvenation Res.* 13(5):561-70.
Curcumin extends life span, improves health span, and modulates the expression of age-associated aging genes in *Drosophila melanogaster*

Brain Research Center

RESEARCHERS

Kwang-Soo Kim kskim@mclean.harvard.edu
- Transcriptional regulatory cascade of the catecholaminergic neuronal system
- Brain diseases of the CA neuronal system
- Embryonic and adult stem cells as potential platforms for developmental biological studies and cell replacement therapy

Won-Gon Kim wgkim@kribb.re.kr
- Screening and characterization of neuro-protective substances derived from natural sources

Jae-Ran Lee leejr@kribb.re.kr
- Protein tyrosine phosphatases and neuronal synaptogenesis
- Novel neuroprotective function of microglia in the brain

Baek-Soo Han bshan@kribb.re.kr
- The role of nuclear receptors in neuroinflammation
- Research on natural compounds which activate nuclear receptors from plant extracts

Kyoung-Shim Kim kskim@kribb.re.kr
- Study of the mechanism of neurodegenerative and psychiatric diseases using animal models
- Research on neuro-protective compounds derived from plant extracts

RESEARCH AREAS

Brain diseases of the catecholamine system
Application of molecular and developmental studies on catecholamine neurons to translational and preclinical research with potential clinical benefits

Embryonic and adult stem cells
Genetic manipulation of stem cells for differentiation to the dopaminergic neuronal lineage

Neuronal development and protein tyrosine phosphatases
Understanding the mechanisms underlying the regulation of neuronal development related to tyrosine dephosphorylation of synaptic molecules

Neuroprotective functions of microglia
Understanding the functions of resting microglia and the applications to neuronal diseases

Role of nuclear receptors in neuro-inflammation
Understanding the anti-neuro-inflammation functions of nuclear receptors in neuro-degenerative diseases

Searching plant extracts for natural compounds having activity for nuclear receptors
Screening plant extracts and identifying nuclear receptor ligands which can activate nuclear receptors
Regulatory mechanisms of anxiety and depression
The application of molecular and behavioral studies using animal models

Regulatory mechanism of anxiety and depression
The application of molecular and behavioral studies using animal models

Our mission is to acquire understanding of and develop treatments for neuro-degerative diseases by conducting basic and clinical research. To improve public mental health, we foster exploration in the fields of cerebral, behavioral, and stem cell sciences.

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ACHIEVEMENTS

Regulation of neuronal development by protein tyrosine phosphatase receptor T (PTPRT) BCR, a neuronal Rac1 GAP, was discovered to be a new substrate of PTPRT; and the regulation of synaptic plasticity in addition to neuronal development.

Screening natural compounds for Parkinsons's Disease drugs
Screening and developments of drugs for Parkinson's Disease by activating nuclear receptors related to dopaminergic neuron development and maintenance.

SELECTED PUBLICATIONS

Jae-Ran Lee (Co-first) *J Neurosci.* 30(42):14134-44.
Regulation of synaptic Rac1 activity, long-term potentiation maintenance, and learning and memory by BCR and ABR Rac GTPase-activating proteins

Integrative Omics Research Center

RESEARCHERS

Ohsuk Kwon oskwon@kribb.re.kr
- Functional genomics and synthetic biology of prokaryotes
- Signal transduction and molecular genetic engineering

Kwang-Lae Hoe kwanghoe@kribb.re.kr
- Functional genomics, synthetic biology, and HCS drug target screening
- Genome-wide gene deletion of fission yeast

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

Dong-uk Kim kimdongu@kribb.re.kr
- Yeast-based HTS system
- Drug-protein interaction using network algorithm

Doo-Byoung Oh dboh@kribb.re.kr
- Development of glycan remodeling technology
- Glycomics study for stem cell and cellular senescence

RESEARCH AREAS

Genomics-based gene deletion research
Construction of genome-wide deletion in fission yeast for functional genomics and drug target screening

Proteomics-based therapeutic antibody research
Target validation and confirmation of cancer targets, production of human antibodies, identification of rheumatoid arthritis modulators

Glycomics-based cellular remodeling research
Integrated genomic analysis of the metabolic regulatory networks and stress response mechanisms; development of glycan remodeling technologies and high-throughput glycan analysis systems

Our goal is to develop platform technologies useful for the production of next-generation bio-therapeutics and high-value-added omics products, such as genome-deleted yeast strains, human therapeutic antibodies, and glycosylated therapeutic proteins. We focus on intelligent cellular engineering and molecular reconstruction technologies, based on an understanding of bio-phenomena on a systemic level and an integrated analysis of various omics data, such as functional genomics, proteomics and glycomics.

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ACHIEVEMENTS

Construction of genome-wide gene deletion in fission yeast
Almost 99% of the fission yeast genome was deleted, and their importance was confirmed through tetrad analysis. Using the mutants and GeneChip, a drug target screening system was established.

Development of a yeast cell factory for the production of therapeutic proteins
Whole genome sequence of the methylotrophic yeast *H. polymorpha* was determined and applied to functional genomics and transcriptomics studies, which are useful for cell factory remodeling. In addition, glycosylation pathways were elucidated and reconstructed to produce human-compatible high-value-added therapeutic glycoproteins.

Development of human antibodies for novel cancer therapeutic targets
The first fully human neutralizing antibodies for TMPRSS4 and CD9 (novel targets for cancer angiogenesis and metastasis), were evaluated and developed for cancer diagnosis and treatment.

SELECTED PUBLICATIONS

Ohsuk Kwon (Corresponding) *Appl Microbiol Biotechnol.* 88(2):497-507.
Characterization of alcohol dehydrogenase 1 of the thermotolerant methylotrophic yeast *Hansenula polymorpha*

Ohsuk Kwon (Co-corresponding) *Appl Microbiol Biotechnol.* 88(4):893-903.
Construction of an in vitro trans-sialylation system: surface display of *Corynebacterium diphtheriae* sialidase on *Saccharomyces cerevisiae*

Ohsuk Kwon (Co-corresponding) *J Biochem.* 147(4):523-33.
Identification and functional characterization of the NanH extracellular sialidase from *Corynebacterium diphtheriae*

Youngwoo Park (Co-corresponding) *J Immunol.* 185(8):4921-7.
Soluble CD93 induces differentiation of monocytes and enhances TLR responses

Kwang-Lae Hoe (Corresponding) *Nat Biotechnol.* 28(6):617-23.
Analysis of a genome-wide set of gene deletions in the fission yeast *Schizosaccharomyces pombe*

BioMonitoring Research Center

RESEARCHERS

Min-Gon Kim mgkim@kribb.re.kr
- High sensitivity detection technology for biomonitoring
- Bioarray technology for rapid and massive analysis of biomaterials

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- Developing analytical devices using modern electronics techniques
- Nanoplasmonics-based biodevices

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- Construction of phage displayed antibody library
- Therapeutic protein production using mammalian expression systems

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

RESEARCH AREAS

Development of high-sensitivity and point-of-care biosensors
Constructing point-of-care biosensors with high sensitivity for applications in medical diagnoses and environmental monitoring

Development of a detection platform for harmful chemicals in food
Constructing novel platform technologies for the detection of harmful materials, such as small endocrine disrupting chemicals and pathogenic bacteria

Building highly efficient and highly sensitive biomaterials-based devices
Developing detection devices based on the integration of biomaterials, such as antibodies, peptides, and oligonucleotides, with microelectronics and microfluidic devices

As an inevitable consequence of a highly industrialized society, a vast multitude of chemical compounds and microorganisms, such as multi-drug resistant bacteria, threaten the hopes of maintaining healthy human life. The BioMonitoring Research Center attempts to build versatile and intelligent biomonitoring systems, not only for conventional food and environmental monitoring; but also for national security concerns, such biochemical terrorism.

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ACHIEVEMENTS

Development of a dual gold nanoparticle conjugate-based LFA sensor
For signal amplification without an additional operational step in a gold nanoparticle (AuNP)-based lateral flow assay (LFA), a new and simple method utilizing two AuNPantibody conjugates was developed. The 1st conjugate was AuNP immobilized with an anti-troponin I antibody and blocked with bovine serum albumin (BSA); the 2nd conjugate was AuNP immobilized with an anti-BSA antibody and blocked with human serum albumin. The two conjugates were encapsulated in different pads.
When 10 nm of the 1st conjugate and 40 nm of the 2nd conjugate were used, detection sensitivity increased about 100-fold compared to the conventional LFA. Levels as low as 0.01 ng/mL troponin I in 10 min were detected using the dual AuNP conjugate-based LFA.

Development of a palm-sized SPR sensor system
A portable surface plasmon resonance (SPR) biosensor system was developed using a rotating mirror. This method eliminates image quality deterioration originating from the coherency of the laser illumination source. A novel portable palm-sized SPR sensor system operated by three batteries (4.5 V) was constructed. The patent for this technology was registered in Korea (PCT/KR2008/004701), and this technology was transferred to KoMiCo Corporation in an agreement for $3 million (USD) in royalties. This project was achieved in collaboration with the BioNanotechnology Research Center.

SELECTED PUBLICATIONS

Yong Beom Shin & Min-Gon Kim (Co-corresponding) *Biosens Bioelectron.* 25(8):1999-2002.
A dual gold nanoparticle conjugate-based lateral flow assay (LFA) method for the analysis of troponin I

Tai Hwan Ha (Corresponding) *Chem Commun (Camb).* 46(18):3164-6.
Complete separation of triangular gold nanoplates through selective precipitation under CTAB micelles in aqueous solution

Min-Gon Kim (Co-corresponding) *Langmuir.* 26(14):12112-8.
Addressable micropatterning of multiple proteins and cells by microscope projection photolithography based on a protein friendly photoresist

Yong Beom Shin (Corresponding) *Sensors.* 10(3):2045-53.
Signal amplification by enzyme reaction in an immunosensor based on localized surface plasmon resonance (LSPR)

Division of Translational Research

Medical Genomics Research Center

Development and Differentiation Research Center

Medical Proteomics Research Center

Byoung Chul Park | Director

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Spurring Progress in Biotreatment Technology

Our work in pioneering fields, such as the development of biomarkers for pathogenic research in cancer and other common life-threatening diseases, and basic technology research in regenerative medicine, harnessing the body's own regenerative capabilities, are making significant contributions to medical science.

Medical Genomics Research Center

RESEARCHERS

Young Il Yeom yeomyi@kribb.re.kr
- Genomic analysis of cancers and identification and functional validation of therapeutic targets

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- Identification and validation of target for cancer therapy

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- Chemical genomic study using cell- or phenotype-based assay, gene and protein expression profiling for identification of the genes and proteins involved in tumor progression and metastasis

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- Epigenomics in gastric and colon cancers

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- Functional validation of candidate target genes and biomarkers for therapeutics/ diagnostics development

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- Identification and functional study of target genes related to gastric, liver and colon cancers

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

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- Isolation and characterization of tumor related molecules

Eun Young Song eysong@kribb.re.kr
- Investigation of cancer diagnostic markers

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- Functional genomics approach to understand human cancers

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- Large-scale screening and identification of cancer-related genes

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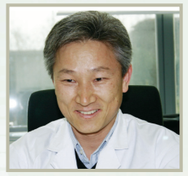
- Functional analysis of genes associated with cancer

Bo Kyung Kim kimbk@kribb.re.kr
- Study of regulation mechanism and validation of therapeutic target genes

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

Our goal is to establish world-class genomics-based technology platforms and to apply them to biomedical research programs. This will achieve high-throughput identification and global function analysis of the genes associated with diseases most prevalent in the Korean population, such as 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.



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ACHIEVEMENTS

Development of therapeutic target genes for liver cancer
We analyzed human HCC tissues using a combination of DNA chip and cell chip technologies and identified 682 genes showing frequent expression changes in HCC and bearing functional relevance to the development of liver cancer. Currently, we are collaborating with Pfizer to define therapeutically valid targets for anticancer drug development for HCC using these omics data.

Identification of a novel tumor suppressor gene, POPDC3, in gastric cancer
We found that the promoter region of Popeye domain-containing protein 3 (POPDC3) was aberrantly methylated in gastric cancer. POPDC3 expression was reduced in 87% of gastric tumors compared with normal adjacent tissues. Combination treatment with a DNA methylation inhibitor and histone deacetylase inhibitor strongly induced POPDC3 expression. POPDC3 were hypermethylated in 64% of gastric cancer tissues. Knockdown of POPDC3 in SNU-216 cells caused increased cell migration and invasion.

Development of tools and algorithms for analyzing omics data
A comprehensive gene expression database comprising more than 35,000 human tissues samples was constructed and it is updated regularly. Also, a gene expression database providing differential expression information after treatment of diverse drugs is being constructed. Many potential drug targets and biomarkers were identified by mining these databases and are being experimentally validated.

Identification of roles of PDLIM7 Enigma in tumorigenesis
We found that Enigma directly forms a complex with Mdm2, inhibits Mdm2 selfubiquitination and stimulates degradation of p53. Expression of Enigma was induced by SRF, and co-expression of SRF-Enigma proteins with Mdm2 was detected in cancer tissues. Our findings suggest a potential role of Enigma in tumorigenesis, and uncover a novel mechanism to attenuate the function of p53 through the SRF-Enigma-Mdm2 pathway.

SELECTED PUBLICATIONS

Mi Sun Won & Kyung Sook Chung (Co-first) *Apoptosis.* 15(12):1540-8.
JNK-mediated transcriptional upregulation of RhoB is critical for apoptosis of HCT-116 colon cancer cells by a novel diarylsulfonylurea derivative

Mi Sun Won (Corresponding) *Biochem Pharmacol.* 80(7):982-9.
LW6, a novel HIF-1 inhibitor, promotes proteasomal degradation of HIF-1α via upregulation of VHL in a colon cancer cell line

Young Il Yeom (Corresponding) *Biomaterials.* 31(7):1858-64.
Gene delivery using a derivative of the protein transduction domain peptide, K-Antp

Byoung-Mog Kwon (Co-corresponding) *Br J Pharmacol.* 159(8):1646-62.
Obovatol attenuates microglia-mediated neuroinflammation by modulating redox regulation

Yong Sung Kim (Corresponding) *Carcinogenesis.* 31(9):1685-93.
Frequent silencing of *popeye domain-containing* genes, *BVES* and *POPDC3*, is associated with promoter hypermethylation in gastric cancer

Young Il Yeom (Corresponding) *Gastroenterology.* 138(5):1898-908.
Functional switching of TGF-beta1 signaling in liver cancer via epigenetic modulation of a single CpG site in TTP promoter

Seon-Young Kim & Yong Sung Kim (Co-corresponding) *Hum Mol Genet.* 19(18):3672-8.
Genome-wide association of serum bilirubin levels in Korean population

Dong-Su Im (Corresponding) *J Clin Invest.* 120(12):4493-506.
Enigma negatively regulates p53 through MDM2 and promotes tumor cell survival in mice

Mi Sun Won (Co-first) *Nat Biotechnol.* 28(6):617-23.
Analysis of a genome-wide set of gene deletions in the fission yeast *Schizosaccharomyces pombe*

Development and Differentiation Research Center

RESEARCHERS

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- Stem cell biology (Embryonic stem cells & induced pluripotent stem cells

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

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

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- Reprogramming of somatic cells

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- Molecular mechanisms underlying the reprogramming process

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- hESC self-renewal and differentiation
- Generation of induced iPSCs

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- Molecular mechanisms of stemness factors
- Small RNA pathways in hESCs/hiPSCs

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- Molecular mechanisms underlying reprogramming for hiPSC pluripotency

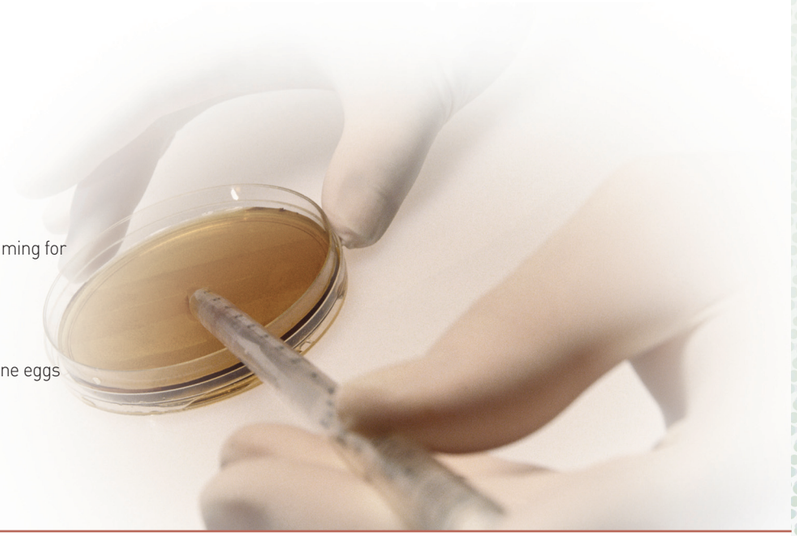
Jung Sun Park jspark@kribb.re.kr
- Somatic cell nuclear transfer
- Micromanipulation of mouse, porcine and bovine eggs

RESEARCH AREAS

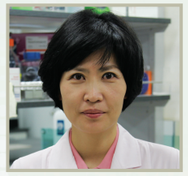
Stem cell biology
- The molecular basis of pluripotency and lineage specification
- Generation of patient-specific ips cells
- iPS-based disease models

Studying molecular and epigenetic mechanisms of early embryo development

Production of transgenic clone pigs for xenotransplantation



Our goal is to develop platform technologies for regenerative biology through fundamental studies on the development and differentiation in human and mammalian life forms.



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ACHIEVEMENTS

The molecular basis of pluripotency and lineage specification
Characterization of signaling pathways that control stem cell pluipotency
Lineage specific differentiation of hESCs using small molecules

Generation and characterization of patient-derived hiPSCs

Molecular control of early embryonic development
Identification of active loss of DNA methylation in two-cell stage goat embryos
characterization of serine-10 phosphorylation on histone H3 shields selectively modified lysine-9 during mitosis

SELECTED PUBLICATIONS

Jeong-Woong Lee (Co-first) *Asian-Aust J Anim Sci*. 23(6):806-13.
Knocking-in of the human thrombopoietin gene on beta-casein locus in bovine fibroblasts

Yong-kook Kang (Corresponding) *Genes Cells*. 15(3):181-92.
Phosphorylation of serine-10 of histone H3 shields modified lysine-9 selectively during mitosis

Yong-kook Kang (Co-corresponding) *Int J Dev Biol*. 54(8-9):1323-8.
Active loss of DNA methylation in two-cell stage goat embryos

Yee Sook Cho (Corresponding) *Stem Cells Dev*. 19(4):557-68.
Rapamycin promotes the osteoblastic differentiation of human embryonic stem cells by blocking the mTOR pathway and stimulating the BMP/Smad pathway

Medical Proteomics Research Center

RESEARCHERS

Byoung Chul Park parkbc@kribb.re.kr
- Target mining and validation using proteomics
- Signal transduction

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- Discovery of novel biomarkers using proteomic analysis
- Stem cell differentiation

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

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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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- Antiapoptotic drug development using NMR studies
- Functional studies on apoptosis-related proteins

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- Target mining and validation using proteomics and reverse genetics tools
- Studies on proteins involved in stem cell differentiation and neurodegenerative diseases

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- Hormone nuclear receptors and their application

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- Structural proteomics, Virtual screening for lead compounds

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Jeong Hoon Kim jhoonkim@kribb.re.kr
- Epigenetics, Transcription regulation

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

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

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

Research on structures and functions
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

We will become the R&D hub of nationwide translational 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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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

Eui-Jeon Woo (Corresponding) *Analyst.* 135(11):2879-86.
Development of a nanoparticle-based FRET sensor for ultrasensitive detection of phytoestrogen compounds

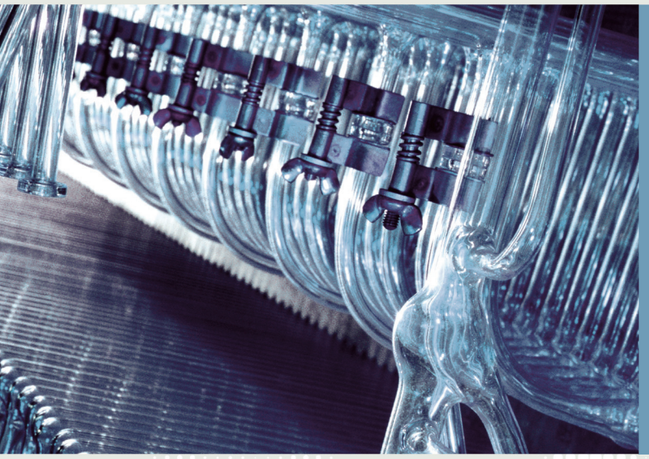
Sung Goo Park & Kwang-Hee Bae (Co-corresponding) *Cell Mol Life Sci.* 67(13):2271-81.
Annexin A4 interacts with the NF-kappaB p50 subunit and modulates NF-kappaB transcriptional activity in a Ca^{2+}-dependent manner

Byoung Chul Park (Co-first) *Cell Mol Life Sci.* 67(15):2619-29.
Positive regulation of apoptosis signal-regulating kinase 1 by dual-specificity phosphatase 13A

Seung Jun Kim (Co-corresponding) *FASEB J. 24(2):560-9.*
Crystal structure of ED-Eya2: insight into dual roles as a protein tyrosine phosphatase and a transcription factor

Eui-Jeon Woo (Co-corresponding) *J Mol Biol.* 404(2):247-59.
Structural insights on the new mechanism of trehalose synthesis by trehalose synthase TreT from *Pyrococcus horikoshii*

Division of Biosystems Research



Industrial Biotechnology & Bioenergy Research Center

Plant Systems Engineering Research Center

Industrial Bio-materials Research Center

Environmental Biotechnology Research Center

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A More Prosperous Future

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 properties of plants, microorganisms and insects and using them to brew new biomaterials; basic bioenergy technology research; and extracting industrial materials from bioresources are some examples of our endeavors in this area.

Industrial Biotechnology & Bioenergy Research Center

RESEARCHERS

Jihyun F. Kim jfk@kribb.re.kr
- Microbial genomics, systems/synthetic biology

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- Yeast protein factory, yeast genetics

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- Microbial genetics, synthetic biology

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- Microbial genome engineering, bioenergy production

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- Metabolic engineering, systems biology

RESEARCH AREAS

Microbial genome analysis
- Genome sequencing and functional genomics of industrial microorganisms; deciphering microbial diversity on a metagenomic scale

Microbial cell/protein factory
- Developing novel expression systems with yeast and bacteria, metabolic pathways engineering, and molecular bacteria-plant interactions

Systems/synthetic biology
- Systems analysis and synthesis of novel biological functions, systems, and life forms by utilizing bio-parts, genetic circuitries, and metabolic pathways

Biocatalyst innovation
- Custom-made enzymes, biomolecular engineering, and innovative biocatalysis processes

Our goal is to become a world-class research and development center specializing in microbial biotechnology by developing the core technologies required for endowing microbial cell factories with novel functions through omics/systems analyses and synthetic biology. The center has established a solid foundation for genomic sciences and biotechnological applications. We have established many international collaborations, and we are actively cooperating with many academic and industrial R&D groups.

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ACHIEVEMENTS

Continued discovery of bacterial biodiversity - maintaining top ranking in the field
Identification of new bacterial taxa and a novel class of metagenome-derived enzymes

Genome analysis of microbes and omics/systems analysis of the *E. coli* cell factory
Genome sequencing and analysis of prokaryotic or eukaryotic microbes of environmental, biotechnological or scientific importance; Genome dynamics and the evolution of bacteria

Construction of a yeast protein factory for the efficient production of recombinant proteins for therapeutics and industry
Genome-wide screening of the TFP library and efficient secretion of production-resistant proteins and enzymes

FRET-based biosensors exhibiting increased signal output and novel specificity
Development of a highly-responsive FRET signal in living cells by combinatorial engineering of the domain linker and binding moiety of CFP-bp-YFP proteins

Development of biocatalytic processes
Biodiesel production with an immobilized and improved lipase; whole-cell biocatalysis

Dissecting probiotic *Paenibacillus*-plant interactions and their genome analysis
Understanding and applying *Paenibacillus*-elicited plant growth promotion and induced resistance, as well as polymyxin and fusaricidin biosynthesis

SELECTED PUBLICATIONS

Jihyun F. Kim (Corresponding) *Appl Environ Microbiol.* 76(5):1661-8.
Genome-wide screening and identification of factors affecting the biosynthesis of prodigiosin by *Hahella chejuensis*, using *Escherichia coli* as a surrogate host

Jihyun F. Kim (Co-corresponding) *J Bacteriol.* 192(23):6317-8.
Draft genome sequence of *Streptomyces clavuligerus* NRRL 3585, a producer of diverse secondary metabolites

Myung Hee Kim (Co-corresponding) *J Biol Chem.* 285(18):14020-30.
Crystal structure of SmcR, a quorum-sensing master regulator of *Vibrio vulnificus*, provides insight into its regulation of transcription

Jae Gu Pan (Corresponding) *J Antimicrob Chemother* 65(6):1171-7.
Signature gene expression profile of triclosan-resistant *Escherichia coli*

Seung-Hwan Park (Corresponding) *J Bacteriol.* 192(22):6103-4.
Genome sequence of the polymyxin-producing plant-probiotic rhizobacterium *Paenibacillus polymyxa* E681

Jung Hoon Sohn (Corresponding) *Anal Biochem.* 398(1):112-6.
Template-blocking PCR: an advanced PCR technique for genome walking

Choong-Min Ryu (Co-first) *Planta.* 232(6):1355-70.
Proteome analysis of Arabidopsis seedlings exposed to bacterial volatiles

Jung Hoon Yoon (Corresponding) *Int J Syst Evol Microbiol.* 60(2):281-6.
Lysinibacillus xylanilyticus sp. nov., a xylan-degrading bacterium isolated from forest humus

Soo-Keun Choi (Corresponding) *J Biotechnol.* 149(1-2):16-20.
Development of a stationary phase-specific autoinducible expression system in *Bacillus subtilis*

Plant Systems Engineering Research Center

RESEARCHERS

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- Comparative, functional and structural genomics of major crops
- Genomics for molecular breeding of Brassica crops
- Evolutionary genomics

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Sung Ran Min srmin@kribb.re.kr
- Development of "CyanoCrops" by introducing cyanobacterial genes into the chloroplast genome of crops
- Cloning of salt resistant genes from marine cyanobacteria via a functional genomics approach and the development of salt-tolerant crops
- Microalgae genetics for biofuels

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Hyun Soon Kim hyuns@kribb.re.kr
- Mass production of the seeds or seedling of useful vegetative-propagation crops
- Development of useful transgenic crops
- Establishment of the optimal system (eg, glycosyation pattern, RNAi knockdown) for molecular farming

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- Photosynthesis regulation and mechanism
- Functions of chloroplast immunophilins
- Identification of rice immunophilins

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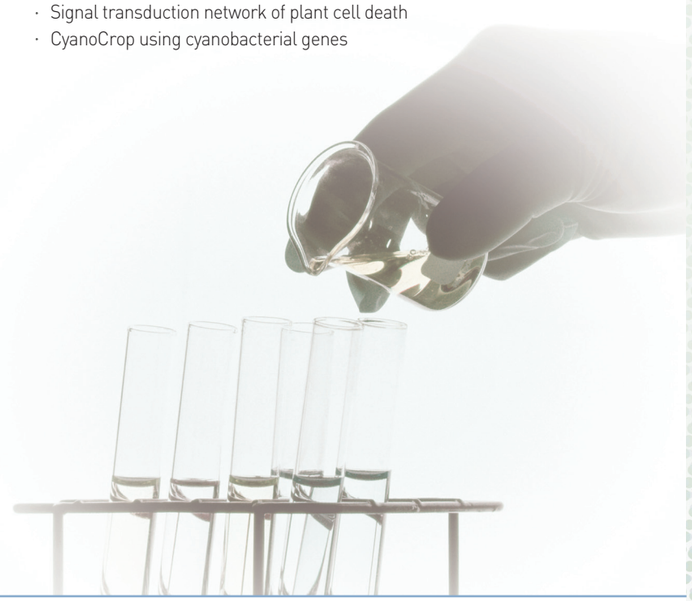
- Molecular mechanisms of pathogen - induced cell death
- Plant immunity to viruses

Jae Sun Moon jsmoon@kribb.re.kr
- Molecular plant-microbe interactions
- Development of the pathogen diagnosis oligo chips
- Identification of the genes involved in the development by virus-induced gene silencing

RESEARCH AREAS

- Plant genome structural, funtional and evolutionary genomics
- Functional genomics of plant-microbe interactions
- Development of an environmentally-friendly binary vector system
- Signal transduction network of plant cell death
- CyanoCrop using cyanobacterial genes



Our center focuses on the development of green technologies and platform technologies to improve important plants. These include identifying functionally important genes as well as establishing a novel transformation system and new transgenic plants with useful traits. We have established platform technologies for structural and functional genomics of important crops by conducting international Solanaceae genome project. We urrently enlarge our genomics platform technology for improving useful crops and developing breeding tools.

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ACHIEVEMENTS

International collaboration on the analysis of the Solanaceae genome
Launched in 2004, this ten-year project involves twenty nations, ten of which are participating in the primary operations to decode the genomic sequence. Korea is responsible for the 2nd chromosome, which consists of 12% of the entire genome. So far, we have accomplished about 90% of our designated task.

Large-scale isolation of pepper genes and public release
We have undertaken the task of gene identification in peppers, the most important vegetable crop in Korea, and have finished analyzing about 120,000 expressed sequence tags. A database containing this information has been built and opened to the public. We believe that we have secured more than two-thirds of the pepper genome, which consists of 30,000 uni-genes, and expect information of varieties to be helpful in the development of new strains. (http://sol.pdrc.re.kr)

Development of platform technology for research on plant functional genomics
Virus-induced gene silencing technology, developed for the large-scale screening of genes is currently being used in the screening of many types of Solanaceae plants including *Nicotiana benthamiana*, peppers, and tomatoes.

Development of transplastomic technology
We have succeeded in developing transformation technology for foreign gene expression in plastids. These genes can only be inherited from the maternal line, which cannot be spread through pollen, thereby ensuring a low environmental risk.

Development of an edible plant-derived vaccine for Alzheimer's disease
Antigens for mutant b-amyloid proteins, which are known to be a cause of Alzheimer's disease, were overexpressed in potatoes as an edible vaccine. We have developed the transgenic potato, and have confirmed through experiments with mice that the potato vaccine does produce specific antibodies for b-amyloids.

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.

SELECTED PUBLICATIONS

Suk Yoon Kwon (Corresponding) *Biochem Biophys Res Commun.* 399(4):750-4.
Silencing of *SlFTR-c*, the catalytic subunit of ferredoxin:thioredoxin reductase, induces pathogenesis-related genes and pathogen resistance in tomato plants

Hye Sun Cho (Co-corresponding) *BMC Plant Biol.* 10:253.
Classification of rice (*Oryza sativa* L. Japonica nipponbare) immunophilins (FKBPs, CYPs) and expression patterns under water stress

Hyun Soon Kim (Corresponding) *Clin Vaccine Immunol.* 17(12):2029-32.
Antibody responses in mice stimulated by various doses of the potato-derived major surface antigen of hepatitis B virus

Suk Yoon Kwon (Corresponding) *J Exp Bot.* 61(9):2499-506.
Tobacco seeds simultaneously over-expressing Cu/Zn-superoxide dismutase and ascorbate peroxidase display enhanced seed longevity and germination rates under stress conditions

Won Joong Chung (Corresponding) *Plant Cell Rep.* 29(9):967-75.
Cucumber mosaic virus 2b protein inhibits RNA silencing pathways in green alga *Chlamydomonas reinhardtii*

Won Joong Chung & Hyun Soon Kim (Co-corresponding) *Transgenic Res.* 19(6):1099-108.
High-level expression of a human β-site APP cleaving enzyme in transgenic tobacco chloroplasts and its immunogenicity in mice

Industrial Bio-materials Research Center

RESEARCHERS

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- Search, in vivo efficacy test, mechanism study, and development of bioactive materials for prevention and treatment of metabolic syndroms (including obesity, hyperlipidemia, atherosclerosis)

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- Development of antiviral, anti-cirrhosis and anti-liver cancer agents using recombinant DNA techniques and identifying active compounds from natural resources

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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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- Microbial Biotechnology
- Enzymes for industrial and bio-energy applications
- Microbial natural products for pharmaceutical uses

Hyun-Woo Oh hwoh@kribb.re.kr
- 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

RESEARCH AREAS

Development of biodiversity-based bio-materials through convergence technologies
- Development of highly active industrial enzymes from insects and microbes
- Development of biological catalysts to solve the biomass recalcitrance for bio-fuels
- Functional study of bio-active substances from insects and microbes

Development of antiviral agents for the treatment of hepatitis B
- Three different antiviral agents were isolated from natural domestic plants.
- These antiviral agents which function differently within the HBV life cycle prevent the appearance of the drug-resistant mutations, which commonly arise during antiviral agent treatment.

Development of a platform technology for metabolic syndrome
- Investigation into the cause of and the discovery of targets for metabolic syndrome
- Screening of bioactive substances for the prevention and treatment of metabolic syndrome and using these subtances for the development of functional foods and nutraceuticals

Development of bio-materials inhibiting microbial functions from natural resources
- Search and development of inhibitors for type III secretion system responsible for the virulence of phytopathogenic bacteria
- Search and development of novel bio-materials, from natural resources, exhibiting biological control effects against phytopathogenic fungi

Research at the Industrial Bio-materials Research Center focuses on the basic and applied studies for the development highly active enzymes for industry, such as potent functional bio-materials for functional foods and therapeutic agents, and biological control agents for agriculture. Our objectives are to discover and develop bio-materials from natural resources and make them available to industry, which increases quality-of-life and public welfare.

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ACHIEVEMENTS

Development of a proteinase, Arazyme
An enzyme that degrades proteins, even under harsh conditions, was developed through a biodiversity-oriented screening system. Through translational research, the enzyme was customized to become an integral part of therapeutics, bio-functional cosmetics, feed additives, detergents, waste-treatment and leather processing. Presently, arazyme-related products are being introduced to the global market by a spin-off company.

Development of highly active xylanase and lipase from insects and microbes
Highly active xylanase and lipase were developed from insects and microbes. These technologies were also transferred to a related corporation for industrialization.

Development of anti-obesity, anti-atherogenic, and anti-diabetic agents for the prevention and treatment of metabolic syndrome from soy leaves
The pterocarpan compounds from soy (*Glycine max*) leaves showed the inhibitory activities of adipogenesis, LDL-oxidation, hACAT, α-glucosidase. In particular, the ethanolic extracts of soy leaves containing pterocarpans reduced body weights and fat tissues in 45 Kcal% fat diet-fed C57BL/6J mice and suppressed arotic lesion formations in high cholesterol-fed LDLr deficient mice. These active materials can be utilized for the development of nutraceuticals and new drugs for the prevention and treatment of metabolic symdrome.

Development of bio-materials inhibiting liver diseases
- Establishment of screening systems for the isolation of the bio-materials treating liver diseases (improving liver functions, hepatitis B virus diseases, liver cirrhosis, liver cancer)
- Isolation and structural determination of biomaterials for curing liver diseases
- Evaluation of efficacy in animal models and in human subjects

Development of bio-materials exhibiting potent anti-fungal effects against phytopathogeic fungi
The dimeric sesquiterpene CHE-23C isolated from *Chloranthus henryi* exhibited 91 and 100% disease-control activity *in vivo* against tomato late blight and wheat leaf rust at concentrations of 33 and 100 μg/ml, respectively. The disease-control activity of this compound was stronger than that of the commercially available fungicide chlorothalonil, but weaker than that of dimethomorph. Therefore, this compound might serve as an interesting link in developing effective fungicides.

SELECTED PUBLICATIONS

Tae-Sook Jeong (Corresponding) *Biol Pharm Bull.* 33(6):1019-23.
Lavandulyl flavonoids from *Sophora flavescens* suppress lipopolysaccharide-induced activation of nuclear factor-kappaB and mitogen-activated protein kinases in RAW264.7 cells

Sung Uk Kim (Corresponding) *Bioorg Med Chem Lett.* 20(22):6551-4.
Synthesis and antifungal activity of a novel series of 13-[4-isopropylbenzyl]berberine derivatives

Kwang-Hee Son & Ho Yong Park (Co-corresponding) *Bioresour Technol.* 101(22):8814-21.
Novel intracellular GH10 xylanase from *Cohnella laeviribosi* HY-21: biocatalytic properties and alterations of substrate specificities by site-directed mutagenesis of Trp residues

Sung Uk Kim (Corresponding) *J Agric Food Chem.* 58(24):12657-63.
Qualitative and quantitative detection of agricultural microorganisms expressing iturin and mop cyclase in soils

Kwang-Hee Son & Ho-Yong Park (Co-corresponding) *J Mol Catal B.* 62(1):32-9.
Catalytic properties of a GH10 endo-β-1,4-xylanase from *Streptomyces thermocarboxydus* HY-15 isolated from the gut of *Eisenia fetida*

Environmental Biotechnology Research Center

RESEARCHERS

Hee-Mock Oh heemock@kribb.re.kr
- Ecophysiological study of microalgae and biological CO_2 fixation using microalgae

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- Transgenic plants with enhanced tolerance to multiple stresses on marginal lands

Haeng-Soon Lee hslee@kribb.re.kr
- Molecular breeding of crops for bioenergy and functional feed on marginal lands

Stephen Beungtae Ryu sbryu@kribb.re.kr
- Enhancement of multi-resistances of plants using natural lipids and plant green biotechnology on natural rubber

Won-Gon Kim wgkim@kribb.re.kr
- Characterization of bioactive substances from microorganisms and environmental sources

Hee-Sik Kim hkim@kribb.re.kr
- Molecular analysis of microbial diversity and functions in contaminated environments

Chi-Yong Ahn cyahn@kribb.re.kr
- Ecogenomics and ecoinformatics of microalgae and cyanobacterial bloom

Jae Cheol Jeong jcjeong@kribb.re.kr
- Transgenic plants with enhanced tolerance to drought stress for combating desertification

Il-Gin Mok mokig@kribb.re.kr
- Molecular breeding of sweetpotato and potato plants for sustainable agriculture

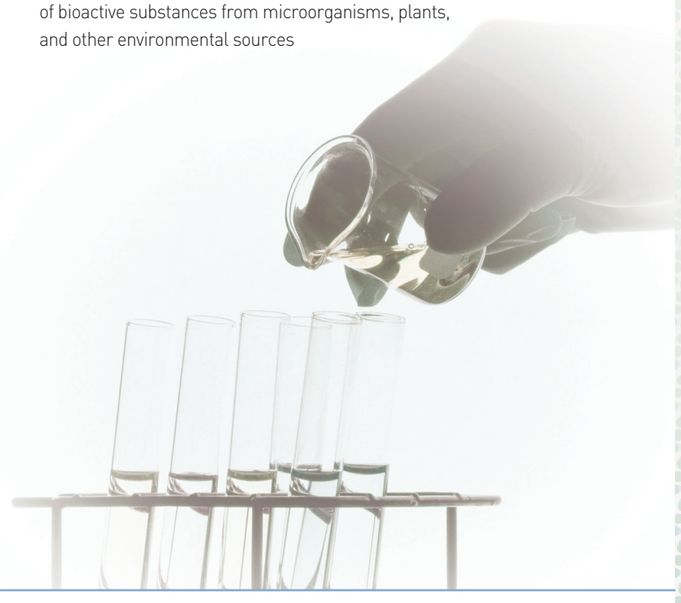
RESEARCH AREAS

Plant antioxidation research
- Developing industrial transgenic plants with enhanced tolerance to multiple environmental stresses for sustainable agriculture on marginal lands

Microalgae research
- Using diverse microalgae in carbon dioxide sequestration and developing environmentally-friendly production technologies for useful materials

Microbial community research
- Developing functional microbial communities for bioremediation of contaminated soil and monitoring microbial diversity and functions

Biomaterials research
- Screening, characterization, and mode-of-action studies of bioactive substances from microorganisms, plants, and other environmental sources



We aim to develop industrial platform technologies using high-tech ecogenomics and biological resources in response to the United Nations Framework Convention on Climate Change. We also investigate water pollution and soil pollution for sustainable development. 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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ACHIEVEMENTS

Development of industrial crops with enhanced tolerance to multiple environmental stresses
Various transgenic crops (e.g. sweetpotatoes, potatoes, poplars) through the gene manipulation of their antioxidative mechanisms were developed for sustainable agriculture on marginal lands. Root-specific promoters are under study for the production of bioenergy and functional feed materials in transgenic sweetpotato plants.

Greenhouse gas reduction and beneficial material production
Outdoor mass bioreactors and microalgae harvesting apparatus were developed which exhibited improved efficiency in carbon dioxide fixation. The resultant microalgae biomass can be used in biofuels, health foods, cosmetics, and medicines.

Development of functional microbial communities for bioremediation
Dozens of functional microbial communities (FMCs), capable of degrading petroleum oil, were obtained from oil-contaminated soil. We developed an effective technologies for FMC preservation and field applications.

New bioactive metabolites from microorganisms
Microorganisms, including microalgae and cyanobacteria, are rich in secondary metabolites with diverse chemical structures and various biological functions. New inhibitors of bacterial fatty acid synthase (FabI, K, G) and peptide deformylase were found in microorganisms for the first time in this study and have potential for new antibacterials.

Environmentally safe natural bioactive substances from plants
Bioactive lipid compounds that enhance multi-resistances in plants to abiotic and biotic stresses were found and are being applied to agricultural fields.

SELECTED PUBLICATIONS

Hee-Mock Oh (Corresponding) *Bioresour Technol.* 101(Suppl 1):S71-4.
Selection of microalgae for lipid production under high levels carbon dioxide

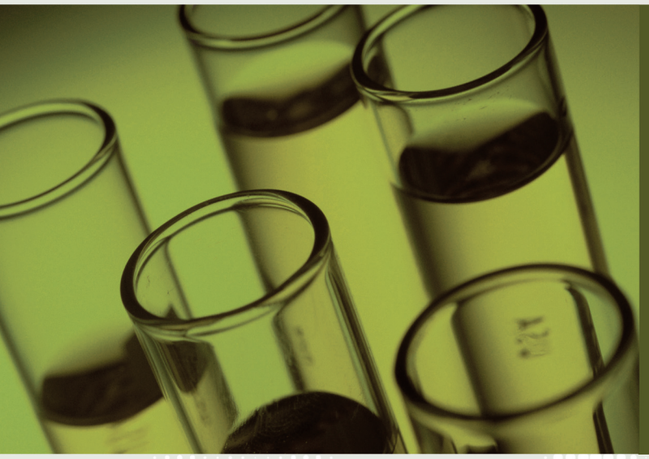
Hee-Sik Kim (Corresponding) *Biotechnol Lett.* 32(12):1829-35.
Complete reductive dechlorination of tetrachloroethene to ethene by anaerobic microbial enrichment culture developed from sediment

Sang-Soo Kwak (Corresponding) *Chemosphere.* 81(1):79-85.
Differential responses of sweetpotato peroxidases to heavy metals

Won-Gon Kim (Corresponding) *Food Chem.* 123(2):501-6.
Isolation and identification of pentagalloylglucose with the broad-spectrum of antibacterial activity from *Rhus trichocarpa* Miquel

Haeng-Soon Lee (Corresponding) *Physiol Plant.* 140(2):153-62.
Enhanced tolerance to methyl viologen-induced oxidative stress and high temperature in transgenic potato plants overexpressing the *CuZnSOD*, *APX* and *NDPK2* genes

Korea Biological Resource Center



Microbial Resource Center

Genome Resource Center

Animal Model Resource Center

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Building Infrastructure for Bio-Competitiveness

As a national bio-infrastructure, the Korea Biological Resource Center (KBRC) has been strengthening to manage bio resources and related information and improving the basis of research support. Also, it has helped to foster the biotechnology industry for providing bio-resource to research institutes, academia and businesses.

Microbial Resource Center

RESEARCHERS

Jung-Sook Lee jslee@kribb.re.kr
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- Management of bacteria and national bio R&D products

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- Management of archaea

Doo-Sang Park dspark@kribb.re.kr
- Management of animal cell lines and DNA barcoding

RESEARCH AREAS

Management of biological resources
- Collection and preservation of core biological resources from foreign and domestic, and distribution of biological resources to academia, industry and researchers

Development of core technologies for valuable bio-resources
- Developing platform technologies for the management, preservation and taxonomy of useful biological resources

Construction of an information network and support of various services
- Construction of local and international network of biological resources and the related information and providing support for workshops, conferences, consultations, etc.

As part of the national bio-infrastructure for biological resources, we are a biotechnology think-tank and perform bio R&D. The main goal of the KCTC (Korean Collection for Type Culture) is to collect, preserve and distribute biological resources.

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ACHIEVEMENTS

Collection, preservation and distribution of biological resources
We acquired over 1,700 strains, including bacteria, actinomycetes, yeasts, filamentous fungi, anaerobes, archaea, animal and plant cell lines, microalgae and patent strains, and preserved about 65,000 cases for long-term preservation in 2010. KCTC was the third ranked culture collection in the world in acquiring new microbial resources in 2010. We distributed over 5,000 strains to academia, industry, and researchers in 2010.

Research activities
We published 48 papers related to biological resources and described 25 new species. We also registered 8 patents, including one international patent. We managed biological resources by barcode-based management system, IRIS, Information of Resource-Indexing System, v3.0, for the implementation of systematic and efficient management.

Construction of an information network and support of various services
We constructed local and international networks of biological resource centers. We also connected biological resource information through national and international database systems because one of our main services is to provide biological resource information to public. We held four workshops and two conferences, and offered consultation and technical support for more than 7,000 cases in 2010.

SELECTED PUBLICATIONS

Jung-Sook Lee (Corresponding) *Int J Syst Evol Microbiol.* 60(2):369-77.
Halomonas stevensii sp. nov., *Halomonas hamiltonii* sp. nov. and *Halomonas johnsoniae* sp. nov., isolated from a renal care centre

Chang Jin Kim (Co-corresponding) *Int J Syst Evol Microbiol.* 60(9):2154-8.
Haloechinothrix alba gen. nov., sp. nov., a halophilic, filamentous actinomycete of the suborder *Pseudonocardineae*

Kee-Sun Shin (Corresponding) *FEMS Microbiol Lett.* 309(2):130-5.
Mucilaginibacter dorajii sp. nov., isolated from the rhizosphere of *Platycodon grandiflorum*

Song-Gun Kim (Co-corresponding) *Appl Environ Microbiol.* 76(17):5827-36.
Identification and characterization of a novel *Terrabacter ginsenosidimutans* sp. nov. beta-glucosidase that transforms ginsenoside Rb1 into the rare gypenosides XVII and LXXV

Byoung-Chan Kim (Corresponding) *Appl Environ Microbiol.* 76(7):2371-5.
Role of *Geobacter sulfurreducens* outer surface *c*-type cytochromes in reduction of soil humic acid and anthraquinone-2,6-disulfonate

Young-Hyo Chang (First) *J Clin Microbiol.* 48(2):545-553.
Application of rpoB and Zinc Protease gene on molecular discrimination of Fusobacterium nucleatum subspecies.

Doo-Sang Park (First) *BMC Genomics.* 11:423.
Recovery of the mitochondrial COI barcode region in diverse Hexapoda through tRNA-based primers

Genome Resource Center

RESEARCHERS

Hong-Seog Park hspark@kribb.re.kr
- Comparative analysis of gene structure between human and chimpanzee brain using bioinformatics tools

Sang-Haeng Choi shchoi@kribb.re.kr
- Construction of genome/cDNA library for animal, plant, and microorganism

Young Joo Kim yjkim8@kribb.re.kr
- Bioinformatics: Disease associated protein network analysis

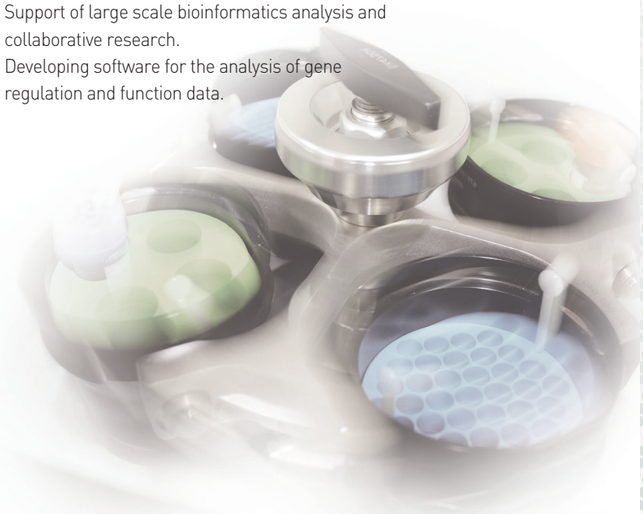
Dae-Soo Kim kds2465@kribb.re.kr
- Bioinformatics: Comparative analysis of primate transcriptome

RESEARCH AREAS

Animal genomes / Plant genomes
- Discovery and characterization of chimpanzee specific fusion genes with the next generation sequencing platform
- The sequencing and de novo assembly of the flatfish genome using NGS methods
- Large-scale screening and identification of disease-related fusion genes
- Mass gene collection of industrially used plants, especially domestically grown medicinal plants
- Bioinformatic analysis of whole human exon capture for high-throughput sequencing

Microbial genome
- Genome sequencing and comparative structure analysis based on massive genome sequencing of various bacteria
- Meta-genome research of environmental organisms

Bioinformatics
- Support of large scale bioinformatics analysis and collaborative research.
- Developing software for the analysis of gene regulation and function data.



Our goal is to understand the biological phenomena of life through genomic science, which is a systematic and comprehensive technology of the genomes of various organisms. The Genome Research Center (GRC) established a solid platform for genomic 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.

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ACHIEVEMENTS

Comparative analysis of the gene structures of chimpanzee and human brains
Of all animals, the chimpanzee most closely resembles humans. We constructed cDNA libraries of the chimpanzee brain (Cerebrum and Cerebellum) and sequenced 26,880 reads. We discovered 14,673 unique genes in the cerebrum and 16,477 unique genes in the cerebellum.

Whole human exome capture for high-throughput sequencing
We captured the entire human exome with hybridization by using synthesized oligonucleotides, based on a high-density microarray design, and we sequenced the exons with high-throughput sequencing on a Genome Sequencer FLX instrument. Of the uniquely mapped reads, 71% fell within target regions, and these corresponded to a coverage of 94% of human genes, 87% of exons, and 70% of the total base-pair length of the CCDS set.

Conjoined gene formation mechanism and expression: insight into the genetic structural landscape of the human genome
Recently, conjoined genes (CGs) have emerged as an important genetic factor necessary for understanding the human genome. However, the formation mechanism and expression patterns of the conjoined genes remained a mystery. We discovered 57 extremely low-expressed novel conjoined gene transcript variants (CGTVs) belonging to five novel human conjoined genes (CGs) homologous to chimpanzee CGs. Through a sophisticated structural analysis (at the sequence level) of these CGTVs, we discovered a novel CG formation mechanism. Also, our structural analysis revealed that exons that are farther from the intergenic region have a higher conservation in the formation of a CG. In addition, we have identified that most newly created novel exons originate from transposable elements. With respect to CG function, we discovered that the CGTVs were expressed in strongly tumor-biased or tumor-specific manners.

Novel insight into transcriptional structures of sperm competition-associated genes by chimpanzee testis transcriptome sequencing
A comprehensive structural analysis of chimpanzee testis sperm competition-associated transcripts may reveal new insights. We sequenced 7,680 clones from a chimpanzee testis full-length cDNA library and obtained 1,933 non-redundant high-quality full-length cDNA sequences. Comparative analysis between human and chimpanzee showed that 78 sperm competition-associated genes (SCAGs), most of which were yet uncharacterized, had undergone severe structural changes (mutations at the start/stop codons, INDELs, alternative splicing variations and fusion forms) on genomic and transcript levels during chimpanzee evolution. Specifically, 39 SCAGs including UBC, ODF2 and CD59 showed markedly chimpanzee-specific structural changes.

SELECTED PUBLICATIONS

Hong-Seog Park (Co-corresponding) *BMC Plant Biol.* 10:253.
Classification of rice (*Oryza sativa* L. Japonica nipponbare) immunophilins (FKBPs, CYPs) and expression patterns under water stress

Hong-Seog Park (Corresponding) *Genome.* 53(7):568-74.
Whole human exome capture for high-throughput sequencing

Hong-Seog Park (Corresponding) *Genome.* 53(9):658-66.
Comparative genomic analysis of the false killer whale (*Pseudorca crassidens*) *LMBR1* locus

Hong-Seog Park (Corresponding) *J Bacteriol.* 192(24):6490-1.
Genome sequence of *Leuconostoc argentinum* KCTC 3773

Hong-Seog Park (Corresponding) *Mol Cells.* 29(2):131-44.
Comparative analysis of expressed sequence tags from the white-rot fungi (*Phanerochaete chrysosporium*)

Animal Model Resource Center

RESEARCHERS

Chul-Ho Lee chullee@kribb.re.kr
- Development of animal models for human metabolic disease
- Discovery and validation of functional genes associated with metabolic disease

Byung-Hwa Hyun hyunbh@kribb.re.kr
- Genetic study of animal models for human neurological diseases
- Development of animal models with non-human primates

Jung Hwan Hwang coccs99@kribb.re.kr
- Phenotyping and development of genetically altered animal models
- Genetic quality control of animal models

Yong-Hoon Kim milknut@kribb.re.kr
- Supports for veterinary care and histopathological analysis
- Microbiological and environmental quality control of animal models

RESEARCH AREAS

- Development and establishment of animal models for human diseases by using transgenic, knock-out and selective breeding techniques
- Research supports for animal experiments, veterinary care, and pathological, hematological and biochemical analyses using animal model resources
- Functional validation of the genes associated with human diseases
- Technical supports for the disease model production and maintenance

The goal of our center is to establish an infrastructure for animal experiments and to generate animal models for human diseases by mutagenesis (such as transgenic, gene targeting and natural breeding) for *in vivo* validation of genes associated with human diseases.

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ACHIEVEMENTS

Animal model establishment and research supports for animal experiments
We have established 3 mouse models for human disease research as transgenic and knockout strains, and supported 84 cases of IACUC-approved animal experiment, 19 cases of pathological experiment, and 30 cases of hematological and biochemical analyses. Also, we have performed (4 times) educational service associated with animal ethics and appropriate animal experiments for animal experimenters and periodical health monitorings (4 times) of animals being maintained for the prevention of disease transmission.

RESEARCH ACTIVITIES

In 2010, we published 17 papers concerning metabolic diseases (arising from our research using disease animal model resources) and registered 2 patents.
Also, we contributed 29 papers for publications resulting from KRIBB research into animal experiment support; including animal husbandry and pathological, hematological and biochemical analyses.

SELECTED PUBLICATIONS

Chul-Ho Lee (Corresponding) *Food Chem Toxicol.* 48(11):3177-83.
Antioxidant effects of the chestnut (*Castanea crenata*) inner shell extract in t-BHP-treated HepG2 cells, and CCl_4- and high-fat diet-treated mice

Chul-Ho Lee (Corresponding) *Food Chem.* 121(2):437-42.
Chestnut (*Castanea crenata*) inner shell extract inhibits development of hepatic steatosis in C57BL/6 mice fed a high-fat diet

Byung-Hwa Hyun (Co-corresponding) *In Vitro Cell Dev Biol Anim.* 46(2):148-54.
The effects of various antioxidants on the development of parthenogenetic porcine embryos

Byung-Hwa Hyun (Co-corresponding) *J Biol Chem.* 285(37):28627-34.
Effects of regulator of G protein signaling 19 (RGS19) on heart development and function

Chul-Ho Lee (Corresponding) *Life Sci.* 87(13-14):405-10.
Differential modulatory effects of rosiglitazone and pioglitazone on white adipose tissue in db/db mice

Ochang Branch Institute

BIO-THERAPEUTICS RESEARCH INSTITUTE

Therapeutic Antibody Research Center
Stem Cell Research Center
Immune Modulator Research Center
Molecular Cancer Research Center
Chemical Biology Research Center

DIVISION OF BIO-INFRASTRUCTURE

Bio-Evaluation Center
Korea National Primate Research Center
Biomedical Mouse Resource Center
Biotechnology Process Engineering Center

Biotech, the New Engine Driving Future Economic Growth

At KRIBB, we work hard to unleash the vast potential of biotechnology to enable medical breakthroughs, through activities like developing antibodies useful for cancer treatment and anti-cancer candidates using functional immune cell techniques. Developing biomarkers for intracable diseases and investigating their functions, identifying and evaluating the effectiveness of new drug candidates, building a database of biopharmaceutical materials and providing support for new drug development are also among the core activities at KRIBB, advancing the limits of biomedical research.

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Therapeutic Antibody Research Center

RESEARCHERS

Sang Seok Koh sskoh@kribb.re.kr
- Studies on targeted therapeutics through cancer genomics
- Mechanistic investigation of novel metastatic factors

Jin-San Yoo hottac@kribb.re.kr
- Development of antibody-based therapeutics
- Engineering of antibodies and beyond for clinical application

Semi Kim semikim@kribb.re.kr
- Identification/validation of novel therapeutic targets in cancer development and metastasis
- Development of anti-cancer biologics drugs

Jeong-ki Min jekmin@kribb.re.kr
- Angiogenesis
- Studies on the functions of cancer markers

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- Protein engineering
- Therapeutic antibody development

RESEARCH AREAS

Cancer cell biology
- Tumor progression and metastasis
- Apoptosis
- Intracellular signaling
- Stem cells

Discovery and validation of drug targets for antibody-based cancer therapies
- Discovery of drug targets through genomics and antibody approaches
- Studies of the role of identified targets in tumor progression
- Validation of drug targets as anti-cancer agents

Development of therapeutic antibodies
- Development of therapeutic antibodies, such as human monoclonal antibodies and humanized antibodies
- Optimization of therapeutic antibodies through affinity maturation
- Construction of mammalian cell lines, producing therapeutic antibodies and proteins
- Production and purification of therapeutic antibodies and proteins
- *In vitro* and *in vivo* study of therapeutic antibodies and proteins

Our goal is to discover new targets for antibody-based cancer therapies and to develop therapeutic antibodies. We also study the molecular mechanisms of cancer progression and validate anti-cancer drug targets.

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ACHIEVEMENTS

Discovery of therapeutic target PAUF for pancreatic cancer therapies and development of human anti-PAUF monoclonal antibodies
The mining of a DNA microarray expression database allowed identification of PAUF as overexpressed in pancreatic cancer and playing an important role in tumor progression and metastasis. Human antibodies targeting PAUF inhibited tumor growth in nude mice bearing human pancreatic cancer.

Discovery of therapeutic target TMPRSS4 for cancer therapies and development of human anti-TMPRSS4 monoclonal antibodies
A Novel type II transmembrane serine protease TMPRSS4 was identified and characterized as a cancer therapeutic target. The new protease proved to be highly up-regulated in lung cancer tissues and is associated with the invasiveness, motility, and cell-matrix adhesion of cancer cells. Human monoclonal antibodies to TMPRSS4 have been developed and their anti-cancer properties are under investigation.

SELECTED PUBLICATIONS

Semi Kim (Co-corresponding) *Carcinogenesis*. 31(4):597-606.
TMPRSS4 induces invasion and epithelial-mesenchymal transition through upregulation of integrin alpha5 and its signaling pathways

Jeong-Ki Min (Co-first) *Circ Res*. 107(7):871-6.
Receptor activator of nuclear factor kappaB ligand is a novel inducer of tissue factor in macrophages

Jeong-Ki Min (First) *Clin Cancer Res*. 16(14):3571-80.
L1 cell adhesion molecule is a novel therapeutic target in intrahepatic cholangiocarcinoma

Sang Seok Koh (Corresponding) *Int J Cancer*. 127(6):1308-20.
The protease inhibitor, elafin, induces p53-dependent apoptosis in human melanoma cells

Sang Seok Koh (Co-corresponding) *Oncogene*. 29(1):56-67.
PAUF functions in the metastasis of human pancreatic cancer cells and upregulates CXCR4 expression

Stem Cell Research Center

RESEARCHERS

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

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- Regulation of NK differentiation from hematopoietic stem cells

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- Molecular mechanism and regulation of NK activation

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- Molecular interaction between NK and tumor cells

Haiyong Jung haiyoung@kribb.re.kr
- Functional studies of the genes involved in NK differentiation

RESEARCH AREAS

NK cell differentiation
- Developing platform technologies for the differentiation of stem cells
- Developing platform technologies for the regulation of NK cell differentiation

NK cell therapy
- Developing NK cell therapies for cancer treatment
- Developing customized NK cell therapies through preclinical studies

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

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ACHIEVEMENTS

Molecular profiling for NK cell differentiation from stem cells
NK cells developed from hematopoietic stem cells (HSCs) in bone marrow. To understand the molecular regulation of NK cell development, a 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, immunotherapies for cancer have been designed. Platform technologies for drug development of cancer immune therapies were established and have been used in the treatment of previously incurable diseases involving immune cells.

Clinical trails with a KRIBB-affiliated company, Medicell Co.
The tailor-made cancer treatment technology consists of extracting adult stem cells from a donor's own marrow, activating natural killer cells, and transfusing them into the patient's body. This technology is currently undergoing investigator-initiated clinical trials in collaboration with the Asan Medical Center, Seoul. Medicell Co, the first KRIBB-affiliated company, is commercializing the technology for anti-cancer immunotherapies using stem cells, which have been developed by the cell therapy research center.

SELECTED PUBLICATIONS

InPyo Choi (Co-corresponding) *Bone Marrow Transplant.* 45(6):1038-46.
Generation of donor natural killer cells from CD34+ progenitor cells and subsequent infusion after HLA-mismatched allogeneic hematopoietic cell transplantation: a feasibility study

InPyo Choi (Corresponding) *Immunol Lett.* 129(2):78-84.
TXNIP regulates germinal center generation by suppressing BCL-6 expression

Suk Ran Yoon & InPyo Choi (Co-corresponding) *Int Immunopharmacol.* 10(4):481-6.
YC-1 enhances natural killer cell differentiation from hematopoietic stem cells

InPyo Choi (Corresponding) *J Immunol.* 185(2):917-28.
Suppressor of cytokine signaling 2 regulates IL-15-primed human NK cell function via control of phosphorylated Pyk2

InPyo Choi (Co-corresponding) *J Immunol.* 185(7):3980-9.
Vitamin D3 upregulated protein 1 suppresses TNF- α-induced NF-κB activation in hepatocarcinogenesis

Immune Modulator Research Center

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 inflammatory diseases

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

Young-Kook Kim kimyk@kribb.re.kr
- Establishment of screening systems for metabolic diseases including atherosclerosis and obesity
- Development bio-active compounds for treatment of metabolic diseases

Kyung-Seop Ahn ksahn@kribb.re.kr
- Evaluation of anti-inflammatory and anti-asthmatic activity of natural products using asthmatic murine model and cell-based assay
- Identification of new bio-markers for asthma treatment

Hyun-Jun Lee hjlee7@kribb.re.kr
- Identification of asthma-regulating genes in vitro & in vivo
- Development of new molecular targets and evaluation of new drug candidates in vitro

Sangku Lee sangku@kribb.re.kr
- Chemical modification of natural compounds for improvement of biological activity
- Organic synthesis for development of new drug candidates

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, coronavirus, rhinovirus and enterovirus

RESEARCH AREAS

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

Chronic disease modulation
- Research 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
- Isolation of bio-active metabolomes from medicinal plants and other natural resources
- Elucidation of natural product structure using analytical instruments (HPLC, LCMS, NMR)
- Modification of natural products and organic synthesis for improving biological activity

Natural product library
- Production of medicinal plant extracts from domestic and foreign sources
- Management of plant extracts bank and natural compounds library

Our aim is to develop natural drugs and drug candidates from medicinal plants and other natural resources which are effective against chronic diseases such as chronic inflammation (asthma), metabolic diseases, viral infection and cancers.

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ACHIEVEMENTS

Identification of natural products effective against chronic diseases
Development of active compounds from natural resources and evaluation of biological activity, especially for asthma, cancer and metabolic disorder

Development of anti-viral agents
For natural anti-viral agents, several kinds of natural substances showing significant activity against white-spot syndrome virus was discovered. Preparations are now being made for its commercialization.

Construction of biomaterial infrastructure
Plant materials were collected and their extracts were deposited in the Plant Extract Bank (over 5,000 domestic and 11,000 international extracts) and distributed to researchers.

Industrial research
We have developed a natural drug for asthma, a neutraceutical for atherosclerosis and drug candidates for cholesterol lowering agents and licensed them to pharmaceutical companies.

SELECTED PUBLICATIONS

Hyeong-Kyu Lee (Co-corresponding) *Br J Haematol.* 148(1):132-43.
MS-1020 is a novel small molecule that selectively inhibits JAK3 activity

Kyung-Seop Ahn (Corresponding) *J Ethnopharmacol.* 130(1):28-34.
Anti-inflammatory effects of methanol extracts of the root of *Lilium lancifolium* on LPS-stimulated Raw264.7 cells

Kyung-Seop Ahn (Corresponding) *J Ethnopharmacol.* 127(1):159-64.
Anti-inflammatory and anti-asthmatic effects of *Viola mandshurica* W. Becker (VM) ethanolic (EtOH) extract on airway inflammation in a mouse model of allergic asthma

Dur-Han Kwon (Corresponding) *Lett Appl Microbiol.* 51(1):1-5.
Inhibitory effects of orobol 7-O-D-glucoside from banaba (*Lagerstroemia speciosa* L.) on human rhinoviruses replication

Young Won Chin (Corresponding) *Phytother Res.* 24(10):1575-7.
Xanthone constituents of the fruits of *Garcinia mangostana* with anticomplement activity

Molecular Cancer Research Center

RESEARCHERS

Hyun Sun Lee leehs@kribb.re.kr
- Isolation and structure determination of biologically active substances from natural products.
- Development of drug candidates/botanical drugs for the prevention and treatment of metabolic diseases such as obesity, type 2 diabetes and hepatic steatosis

Jung Joon Lee jjlee@kribb.re.kr
- Discovery and optimization of anti-cancer drugs-lead from chemical library and natural products targeted NF-kB, HIF-1, and PPAR and evaluation of their efficacy in animal models
- Molecular pharmacology and target discovery of bioactive natural products

Young-Soo Hong hongsoo@kribb.re.kr
- Molecular genetic analysis of natural products biosynthesis.
- Synthetic biotechnology of artificial biosynthetic pathways.
- Discovery and optimization of anti-cancer drugs-lead from Microbial metabolites targeted Hsp90 protein

Sunhong Kim sunhong@kribb.re.kr
- Screening a novel signaling pathway in *C. elegans* and mammalian system
- Development of assay systems for drug discovery

RESEARCH AREAS

- Target identification and validation
- Discovery of molecular targets for anti-cancer drug development and biological and chemical validation of the targets
- Discovery and optimization of anti-cancer drugs from chemical libraries and natural products and evaluation of their efficacy
- Elucidation of molecular mechanisms of drug candidates
- Molecular genetic manipulation of natural products Biosynthesis

The goals of the molecular cancer research center are to discover novel molecular targets for anticancer drug screening and to develop anti-cancer drug candidates against these targets. We apply functional and chemical genomics to identify the genes and proteins involved in cancer onset, progression, and metastasis. To identify the novel anti-cancer agents, we screen chemical libraries and natural products using cell-based assay systems.

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ACHIEVEMENTS

Development of a small molecule inhibitor of HIF pathway
Structural modification of a compound discovered during high-throughput screening using an HRE-dependent reporter assay revealed a novel class of HIF-1 inhibitors, which potently inhibits HIF-1a protein accumulation and its target gene expression under hypoxic conditions in human hepatocellular carcinoma Hep3B cells.

Validation of DRG9 in an animal model as an oncogene
A novel protein, DRG9, was identified via the elucidation of a molecular mechanism of a p50 selective inhibitor, a natural diterpene compound. This protein, induced by a variety of kB activators, potently stimulates kB target gene expression, p65/RelA transcriptional activity, and HIF-1a accumulation. Furthermore, over-expression of DRG9 in cancer cells significantly increased its anchorage independent growth, invasiveness, and angiogenic activity, suggesting that DRG9 could be an oncogenic protein.

Improved Hsp90 inhibitors by engineering the geldanamycin biosynthetic genes.
We developed a series of potent heat shock protein (Hsp) 90 inhibitors based on the polyketide natural product geldanamycin via biosynthetic gene engineering techniques. There is huge potential to create novel organic molecules through deliberate *in vivo* and *in vitro* engineering of these pathways for the production of human and veterinary pharmaceuticals, specialty chemicals, and high value biomaterials.

SELECTED PUBLICATIONS

Hyun Sun Lee (Co-corresponding) *Biol Pharm Bull.* 33(3):450-4.
Preventative effects of *Platycodon grandiflorum* treatment on hepatic steatosis in high fat diet-fed C57BL/6 mice

Jung Joon Lee (Corresponding) *Biochem Biophys Res Commun.* 400(4):581-6.
Zinc-finger protein 91 plays a key role in LIGHT-induced activation of non-canonical NF-κB pathway

Sunhong Kim (Co-first) *J Biol Chem.* 285(11):8122-9.
Regulation of FOXO1 by TAK1-Nemo-like kinase pathway

Jung Joon Lee (Corresponding) *J Biol Chem.* 285(40):30539-47.
An atypical E3 ligase zinc finger protein 91 stabilizes and activates NF-kappaB-inducing kinase via Lys^{63}-linked ubiquitination

Jung Joon Lee (Corresponding) *J Nat Prod.* 73(6):1167-9.
An isoaurone and other constituents from *Trichosanthes kirilowii* seeds inhibit hypoxia-inducible factor-1 and nuclear factor-kappaB

Young-Soo Hong (Co-corresponding) *Tetrahedron Lett.* 51(2):351-3.
New tricyclic geldanamycin analogues from an engineered strain of *Streptomyces hygroscopicus* JCM4427

Chemical Biology Research Center

RESEARCHERS

Jong-Seog Ahn jsahn@kribb.re.kr
- Microbiology and Cell biology
- Metabolomics

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- Oxidative stress and antioxidants

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- Marine natural product chemistry
- Microbial chemistry

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- Natural product chemistry

Ick-Dong Yoo idyoo@kribb.re.kr
- Natural product chemistry
- Cosmetics material science

RESEARCH AREAS

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 oriental herbs and plant resources

Epigenomic modulators
- Developing bioactive compounds regulating DNA methyltransferase-mediated gene expression and carcinogenesis

Beauty
- Discovering novel inhibitory compounds against melanin synthesis and skin damage

Microbial metabolite biotechnology
- Discovering bioactive secondary metabolites and compiling a library of microbial secondary metabolites

The goal of the research center is discovering bio-functional drug candidates from the metabolites of microorganisms and plants and defining the function of their cellular targets for application to chemotherapeutics development. To accomplish this goal, we adopt chemical biology techniques based on biometabolites and cellulomics technology to develop medicinal and bio-functional compounds.

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ACHIEVEMENTS

Isolation of ER-stress inducers and inhibitors
An endoplasmic reticulum (ER)-stress inducer was isolated from a plant extract. This compound strongly induced the expression of ER-stress-associated proteins, including GRP78 chaperone, and the splicing of XBP-1 mRNA, a hallmark of ER-stress-induced IRE-1a activation. On the other hand, an inhibitor of ER-stress was also isolated to be used as an inhibitor of type II diabetes mellitus. Both of them are expected to challenge cancer therapeutics and anti-diabetes.

Isolation of osteoclast differentiation inhibitors
Bone marrow cells were isolated from mice and induced to differentiate into osteoclasts. Metabolites were screened and purified from oriental herbs, including black ginseng, to be effective utilizing TRAP assay and staining methods. These compounds are promising candidates for osteoporosis treatment.

Isolation of DNA methyltransferase inhibitors and new target tumor suppressors genes
Purified compounds from a fungus were found to have an inhibitory activity against human DNA methyltransferase-1 in vitro and cellular system. The compounds elevated tumor suppressor gene expression in HCT116 cells. In addition, a few tumor suppressor genes were revealed to be regulated by DNA methylation in K-ras overexpressing prostate cancer cells. Hence the compounds and the targets are valuable for chemotherapeutics development.

SELECTED PUBLICATIONS

Ick-Dong Yoo (Corresponding) *Bioorg Med Chem Lett.* 20(2):513-5.
Evaluation of human neutrophil elastase inhibitory effect of iridoid glycosides from *Hedyotis diffusa*

Bo Yeon Kim & Jong-Seog Ahn (Co-corresponding) *Carcinogenesis.* 31(7):1194-201.
Modulation of E-cadherin expression by K-Ras; involvement of DNA methyltransferase-3b

Ick-Dong Yoo (Corresponding) *J Antibiot (Tokyo).* 63(6):335-7.
Lactariolines A and B: new guaiane sesquiterpenes with a modulatory effect on interferon-gamma production from the fruiting bodies of *Lactarius hatsudake*

Ick-Dong Yoo (Corresponding) *J Microbiol Biotechnol.* 20(8):1189-91.
Hydoroxyhibiscone A, a novel human neutrophil elastase inhibitor from *Hibiscus syriacus*

Jong-Seog Ahn (Corresponding) *Phytother Res.* 24(11):1716-9.
Protein tyrosine phosphatase 1B inhibitory activity of 24-norursane triterpenes isolated from *Weigela subsessilis*

Bio-Evaluation Center

RESEARCHERS

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- Risk assessment of LMOs / Evaluation of anticancer and immunomodulating drug candidates / Toxicopharmacology

Soon-Chun Jeong scjeong@kribb.re.kr
- Genetics of Plant Disease Resistance Genes / Molecular Genetic Characterization of LMOs / Soybean Genomics

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- Plant and fungal ecology / Environmental risk assessment of LMO

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- Weed physiology and ecology
- R&D LMO safety management / Environmental risk

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- Evaluation of anticancer drug candidates / Molecular pharmacology

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- Biopharmaceutics

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

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- Cancer signaling
- Efficacy evaluation of anti-cancer agents

RESEARCH AREAS

Living modified organisms (LMOs)
- Conducting genetic analysis and assessing the risks of LMOs

New drugs
- Discovery and preclinical evaluation and optimization of new drug candidates

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.

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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 for watermelons. 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, ADME and toxicity 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

Hwan Mook Kim & Jong Soon Kang (Co-first) *Int Immunopharmacol.* 10(1):72-8.
Evaluation of antidiabetic activity of polysaccharide isolated from *Phellinus linteus* in non-obese diabetic mouse

Chang-Gi Kim & Hwan Mook Kim (Co-corresponding) *Food Control.* 21(4):456-61.
Monitoring the occurrence of genetically modified maize at a grain receiving port and along transportation routes in the Republic of Korea

Soon-Chun Jeong (Corresponding) *J Hered.* 101(6):757-68.
Genetic analysis of genes controlling natural variation of seed coat and flower colors in soybean

Song-Kyu Park (Corresponding) *J Pharmacol Exp Ther.* 334(2):657-64.
DBM1285 suppresses tumor necrosis factor alpha production by blocking p38 mitogen-activated protein kinase / mitogen-activated protein kinase-activated protein kinase 2 signaling pathway

Song-Kyu Park & Hwan Mook Kim (Co-corresponding) *Oncol Rep.* 23(3):801-9.
KBH-A42, a histone deacetylase inhibitor, inhibits the growth of doxorubicin-resistant leukemia cells expressing P-glycoprotein

Korea National Primate Research Center

RESEARCHERS

Kyu-Tae Chang changkt@kribb.re.kr
- Developing cell and tissue resources derived from non-human primates and conducting research for their applications
- Developing new breeder miniature pigs for research and development of bio-organs

Ekyune Kim kimek@kribb.re.kr
- Study on the functional relationship of membrane proteins involved in mammalian fertilization
- Down-regulation of membrane proteins through endocytosis mechanism

Sang-Hyun Kim skim@kribb.re.kr
- Microbiological monitoring of specific-pathogen free animals
- Structure / function studies of outer membrane vesicles

Sun-Uk Kim sunuk@kribb.re.kr
- Stem cell research in mammals
- Reproductive developmental biotechnology

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

Jae-Won Huh huhjw@kribb.re.kr
- Human and non-human primate comparative genomics / Primate molecular genetics / Primatology
- Identification and molecular characterization of primate genes

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

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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RESEARCH AREAS

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

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

Acquisition of primate resources
Primates provide valuable opportunities in providing non-human physiological and anatomical data required for biomedical research and applications. 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 209 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.

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. For the introduction of the baboon monkey, we cooperated with the Washington, Tulane, and Southwest National Primate Research Centers, and 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) *Biochem Biophys Res Commun.* 403(2):167-71.
Implication of mouse Vps26b-Vps29-Vps35 retromer complex in sortilin trafficking

Kyu-Tae Chang (Corresponding) *BMC Genomics.* 11:427.
Full-length cDNA sequences from Rhesus monkey placenta tissue: analysis and utility for comparative mapping

Kyu-Tae Chang (Corresponding) *FEMS Immunol Med Microbiol.* 58(3):412-20.
Shiga toxin A subunit mutant of *Escherichia coli* O157:H7 releases outer membrane vesicles containing the B-pentameric complex

Kyu-Tae Chang (Corresponding) *Genomics.* 96(5):266-71.
Bioinformatic analysis of TE-spliced new exons within human, mouse and zebrafish genomes

Kyu-Tae Chang (Co-corresponding) *J Pineal Res.* 49(3):201-9.
Melatonin plus exercise-based neurorehabilitative therapy for spinal cord injury

Biomedical Mouse Resource Center

RESEARCHERS

Hyoung-Chin Kim hckim@kribb.re.kr
- Experimental Animal Medicine
- Toxicology
- Health Safety of LMO

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- Experimental Animal Medicine
- Mouse Stem Cell
- Reproductive engineering

Won-Kee Yoon wkyoon@kribb.re.kr
- Veterinary Pathology
- Genetic monitoring of laboratory animals
- Health Safety of LMO

Young-Suk Won yswon@kribb.re.kr
- Bacteriology
- Health monitoring of laboratory animals

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 disease models
- Training of laboratory animal techniques

Mice are an essential resource for functional genetic research and biomedical drug development. Our aim, as a national infrastructure, is to establish a domestic representative infrastructure of resources, technologies, facilities and manpower to support laboratory animal resource center, especially mouse resources. For this purpose, we have been collecting, preserving and distributing laboratory animal resources since 1984. We are developing technologies for the quality control of the laboratory animals, especially microbiological and genetically monitoring, and for the development of genetically engineered mice. We also cooperate with several international organizations in mouse resources.

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ACHIEVEMENTS

A highly representative and the largest Korean laboratory animal resource bank
- Deposits of laboratory animal resources : 300 strains
- Distribution of laboratory animal resources : 4,140 animals

Quality control center for laboratory animals
- Health monitoring : 2,824 animals
- Genetic monitoring : 5 strains
- Mouse genotyping : 3,985 animals
- Animal clearing : 34 strains

Preservation of laboratory animal resources as frozen resources
- Embryo freezing : 70 strains
- Sperm freezing : 33 strains

Training in laboratory animal techniques
- The 33rd Laboratory Animal Workshop was held on November 23, 2010.

Technical advice and animal testing support
- Blood chemical analysis : 1,100 animals
- Technical advice : 33 cases

International cooperation with ICLAS and AMMRA
ICLAS : International Council for Laboratory Animal Science
AMMRA : Asian Mouse Mutagenesis Resource Association

RESEARCH ACTIVITIES

We are attempting to identified the in vivo functions of the Vitamin D3 up-regulated protein 1(VDUP1) gene in liver carcinogenesis.
The underlying mechanisms study revealed that VDUP1 negatively regulated hepatocarcinogenesis by suppressing TNF-α-induced NF-κB activation (*J Immuno* 2010. 185:3980-3989). In the case of gastric cancer, a lack of VDUP1 increased *Helicobacter pylori*-induced gastric carcinogenesis through the modulation of chronic inflammation, oxidative stress and induction of COX-2 and PGE_2. Using human clinical samples, the expression patterns of VDUP1 genes at the protein and mRNA levels were investigated and a good correlation between mouse study results and human samples was found. The research is now being extended into the specific molecular mechanisms by which VDUP1 exerts tumor suppressor activity. The role of the VDUP1 in the regulation of cell growth, survival, and apoptosis is being characterized using engineered mouse models and cell culture models. It was observed that VDUP1 inhibits cell proliferation and cell-cycle progression by regulating ERK1/2 and Akt signaling pathways (*J Hepatol* 2010, in press).

SELECTED PUBLICATIONS

Hyoung-Chin Kim (Co-corresponding) *J Immunol.* 185(7):3980-9.
Vitamin D3 upregulated protein 1 suppresses TNF-α-induced NF-κB activation in hepatocarcinogenesis

Hyoung-Chin Kim (Corresponding) *Toxicol Appl Pharmacol.* 242(3):344-51.
The role of osteopontin in D-galactosamine-induced liver injury in genetically obese mice

Biotechnology Process Engineering Center

RESEARCHERS

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- Fermentation physiology & Microbial engineering
- Bioprocess engineering

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- Molecular breeding of fungi and yeast

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- Separation and purification

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- Biochemical engineering
- Animal cell culture

RESEARCH AREAS

Bioprocess development and scale-up
- Process development and scale-up studies on microbial expression systems, fermentation, downstream process and chromatographic purification

Microbial fermentation and animal cell culture
- High quality and high yield production of valuable metabolites, carbohydrates, enzymes, and recombinant proteins by batch, fed-batch and continuous cultures

Production of biomaterials and biopharmaceuticals
- Process development for the production of bioactive compounds, fine chemicals, biofuels, enzymes, carbohydrates, and biopharmaceuticals

We aim to develop 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 cultivating human resources through academic-industrial collaboration.

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ACHIEVEMENTS

Development of biological process for the production of microbial metabolites
We have developed pilot-scale processes for the production of microbial metabolites such as amino acids (ornithine, threonine, and proline), antibiotics, and shikimic acid. This technology includes not only process development but also strain development by traditional mutagenesis and use of genetically-engineered strains.

Over-expression and purification of recombinant proteins
We have developed technology for the production of heterologous proteins of interest in both E. coli and P. pastoris. This technology, which involves over-expression of a target protein, fusion tag selection, cleavage optimization, and serial chromatographic purification, can be applied to manufacturing therapeutic proteins and functional enzymes.

Development of a novel Pichia expression system
P. pastoris is increasingly used as a host system for heterologous protein expression for both academic and industrial processes. In this system, most recombinant proteins have been produced using the alcohol oxidase I promoter (PAOX1), for which the highly volatile and inflammable compound methanol is required for transcription. As alternatives to PAOX1, we developed two strong methanol-free promoters: translation elongation factor 1a promoter (PTEF1) with highly growth-associated expression characteristics and phosphate-responsive promoter (PPHO89) of a sodium phosphate symporter. Also, a cost-effective and simple PTEF1- and PPHO89-based fermentation process was developed for industrial applications. Furthermore, we developed 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.

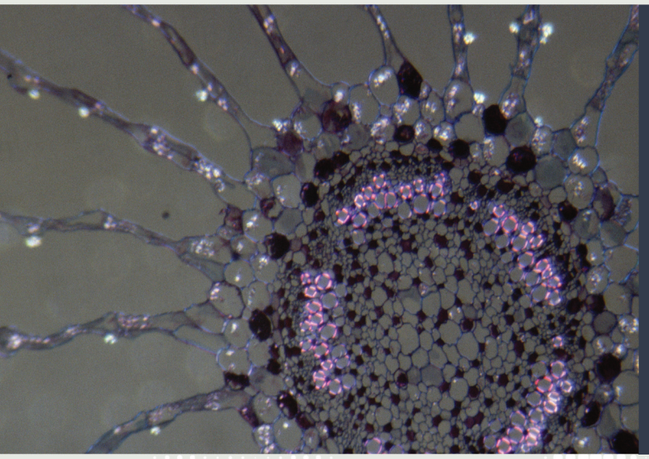
Developement of *in silico* constraints-based flux analysis tool based on the cofactor regeneration view
We have developed *in silico* constraints-based flux analysis tool which can characterize the experimentally observed microbial cell growth, metabolite production, and their corresponding metabolic states based on the cofactor regeneration view. Using this tool, we have comparatively investigated the overall phenotypic effects of specific gene-knockout and carbon source utilization on cell growth and target metabolites, such as shikimic acid and isoprene. Subsequent constraints-based flux analysis of genome-scale *E. coli* metabolic model allowed us to gain non-intuitive insights into the metabolic requirements of target metabolite biosynthesis with respect to NADPH regeneration. Such *in silico* analysis can potentially be used for a better understanding of cellular physiology in various metabolic engineering studies, e.g., cofactor engineering, in the future.

SELECTED PUBLICATIONS

Hong Weon Lee (Co-author) *Microb Cell Fact. 9:e50.*
Genome-scale metabolic reconstruction and *in silico* analysis of methylotrophic yeast *Pichia pastoris* for strain improvement

Eun Gyo Lee (Co-author) *Comp Immunol Microbiol Infect Dis. 33(6):e41-9.*
Suppression of proinflammatory cytokine production by specific metabolites of *Lactobacillus plantarum* 10hk2 via inhibiting NF-κB and p38 MAPK expressions

Jeonbuk Branch Institute



Microbe-based Fusion Technology Research Center

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Enhancing Industrial Value of Biotechnology through Development of New Biomaterials Technologies

The 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.

Microbe-based Fusion Technology Research Center

RESEARCHERS

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- Development of platform technologies for massive screening and the commercialization of industrially valuable enzymes using the HTS system
- Development of the technology to prepare a genomic library from single unculturable microorganisms sorted from nature

Chul Ho Kim kim3641@kribb.re.kr
- Bioprocess
- Bio-refinery

Joong Su Kim joongsu@kribb.re.kr
- Development of the glycosyltransferases useful for the manufacturing of glycodrugs and the glycosylation of natural compounds
- Development of the aldolases applicable to the white biotechnology
- Development of protocol to screen industrial enzymes from metagenome

Jeong-Woo Seo jwseo@kribb.re.kr
- Metabolic pathway engineering in microorganisms

J**ong Hyun Choi** jhchoi@kribb.re.kr
- Development of platform technologies for screening useful enzymes using High Thoughput Screening System
- Development of the tool box applicable to the white biotechnology based on systems 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

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 phamaceutic, nutraceutic, dietetic, cosmetic, feed, fine chemical and other industries.

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ACHIEVEMENTS

Development of 1,3-propanediol producing microbial strains
Recombinant strains optimized to produce 1,3-propanediol using crude glycerol, derived from biodiesel industry by-products, were developed through metabolic pathway engineering. Notably, the occurrence of by-products, which are usually an obstacle in the purification process of 1,3-propandiol, was completely abolished in the engineered strains, resulting in conversion yields with the highest levels reported to date.

Development of human papillomavirus vaccine
Several types of human papillomavirus L1 genes encoding the major capsid protein were expressed in Escherichia coli. The structural proteins were found to be immuno-active by western blotting analysis and synthesized the virus-like particles by self-assembly in the heterologous host.

Screening of the novel enzymes
Novel 2-deoxyribosephosphate aldolases, glycosyltransferases, cellulases, lipases, and proteases were screened and isolated from nature, and cloned into *E. coli*.

Preparation of a genomic library from a single microorganism
Multiple Displacement Amplification technology was applied to the amplification of genomic DNA isolated from single cell, from which novel cellulase was selected.

SELECTED PUBLICATIONS

Chul Ho Kim (Corresponding) *Appl Microbiol Biotechnol.* 85(3):659-66.
Identification and utilization of a 1,3-propanediol oxidoreductase isoenzyme for production of 1,3-propanediol from glycerol in *Klebsiella pneumoniae*

Jeong-Woo Seo (Corresponding) *Biotechnol Lett.* 32(8):1077-82.
Enhanced production of ethanol from glycerol by engineered *Hansenula polymorpha* expressing pyruvate decarboxylase and aldehyde dehydrogenase genes from *Zymomonas mobilis*

Jae Jun Song (Corresponding) *Int J Syst Evol Microbiol.* 60(3):615-9.
Jeongeupia naejangsanensis gen. nov., sp. nov., a cellulose-degrading bacterium isolated from forest soil from Naejang Mountain in Korea

Chul Ho Kim (Corresponding) *J Ind Microbiol Biotechnol.* 37(2):195-204.
Gene cloning, characterization, and heterologous expression of levansucrase from *Bacillus amyloliquefaciens*

Joong Su Kim (Corresponding) *Microbiol Res.* 165(5):384-91.
Purification and characterization of a novel glucansucrase from *Leuconostoc lactis* EG001

Eco-Friendly Biomaterial Research Center

RESEARCHERS

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

Mun-Chual Rho rho-m@kribb.re.kr
- Identification of inflammation related target molecules and establishment of screening systems for inflammation related diseases
- Isolation and structure elucidation of active compounds

Su-Jin Park sjpark@kribb.re.kr
- Isolation and bulk culture of viruses (Coronavirus, Rotavirus, Influenzavirus, etc) and genetic and phylogenic analysis of isolated viruses
- Pathologic, immunohistochemical, electron microscopic studies using animals

Young-Min Kim u9897854@kribb.re.kr
- Development of solubilized process of active compounds and mass production
- Enzymatic modification of infection and inflammation related target molecules

Young Bae Ryu ybryu@kribb.re.kr
- Isolation and identification of secondary metabolites from natural resources
- Identification of infection related target molecules and establishment of screening systems for infection related diseases

RESEARCH AREAS

Construction of a bioassay system related to infectious 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.

Construction of a bioassay system related to inflammatory diseases
- Establishment of a bioassay and screening system for such compounds against inflammatory diseases (pneumonia, asthma, arthritis, etc.)
- Development of specifically active compounds such as inhibitors of cell adhesion molecules, cytokine and chemokine.

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

Our aim is to develop functional foods, natural feeds and therapeutic materials against infectious (viruses, bacteria and malaria) and inflammatory (pneumonia, asthma, arthritis, etc.) diseases from the natural product library, starting with traditional medicines.

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ACHIEVEMENTS

Identification of biomaterials against infectious and inflammatory 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. Additionally, cell adhesion molecules (ICAM-1/LFA-1, VCAM-1/VLA-4), cytokines and chemokines, participate in cell to cell interactions, which is important in the progression of the inflammatory response in diseases such as pneumonia, asthma, etc. Therefore, we have developed active biomaterials from natural resources with in vitro assay systems for infectious and inflammatory diseases, and have obtained bioactive compounds from selected biomaterials using chromatographic techniques.

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

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

Su-Jin Park (Co-corresponding) *Arch Virol.* 155(3):417-22.
Detection and molecular characterization of porcine toroviruses in Korea

Woo Song Lee (Co-corresponding) *Bioorg Med Chem.* 18(17):6258-64.
Xanthones with neuraminidase inhibitory activity from the seedcases of *Garcinia mangostana*

Woo Song Lee (Co-corresponding) *Bioorg Med Chem Lett.* 20(3):971-4.
Inhibition of neuraminidase activity by polyphenol compounds isolated from the roots of *Glycyrrhiza uralensis*

Woo Song Lee & Mun-Chual Rho (Co-corresponding) *Planta Med.* 76(14):1544-9.
Kansuinine A and Kansuinine B from *Euphorbia kansui* L. inhibit IL-6-induced Stat3 activation

Su-Jin Park & Woo Song Lee (Co-corresponding) *Virol J.* 7:307.
In vitro inhibitory activity of *Alpinia katsumadai* extracts against influenza virus infection and hemagglutination

Bioindustrial Process Center

RESEARCHERS

Hyo Kon Chun hkchun@kribb.re.kr
- Development of the polyphenolic healthcare biomaterials
- Combinatorial fermentation of the food using GRAS grade microorganisms
- Bioconversion of agricultural byproducts into healthcare biomaterials

Byung Dae Yoon bdyoon@kribb.re.kr
- Construction of a base for the development of the regional bio-industry based on research into microbial-materials for agriculture and stockbreeding
- Development of mass production processes and analysis of immune activity of b-glucan purified from Aureobasidium sp.

Joong Su Kim joongsu@kribb.re.kr
- Development of the useful enzymes for glycosylation of bioactive compound
- Development of bio-process for glycosylation of polyphenol
- Enzymatic bioconversion of bio-materials for enhanced bioavailability

Min Soo Kim ms5732@kribb.re.kr
- Development of a microbial fermentation process
- Bioconversion of a highly intensive sweetener derived from waste orange Peel
- Screening and application of useful microorganisms derived from Korean traditional fermented foods

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- Molecular metabolic engineering for production of secondary metabolites in microbe and plant systems
- Development of intragenic vector systems using all-native DNA and production of intragenic plants
- Understanding of molecular mechanisms for the biosynthesis of plant pigments
- Molecular plant-microbe interactions
- Molecular farming for the production of valuable proteins in plant systems

RESEARCH AREAS

Development of mass-production technologies for useful biological compounds and research into practical technologies via field applications
- Search for new functional biological compounds
- Development of mass-production technologies for useful biological compounds using pilot plants
- Development of technologies for applications in the field, and for the commercialization of useful compounds

Our goal is to develop the technologies required for the mass-production of microorganisms and their metabolites. Additional objectives of the center include the construction of a base for the development of a regional bio-industry via a technical support business aimed at the activation of agriculture and stock breeding, and research into the industrialization and mass production of useful bio-materials.

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ACHIEVEMENTS

Environmentally-friendly agriculture based on biological control technologies
To meet the demands of an ever-increasing global population, agriculture in the next decades will have to produce more food from less land based on a more efficient and sustainable use of natural resources, while having a minimal impact on the environment. Promoting and adopting "environmentally-friendly agriculture via biological control technologies and its management systems" could help us to reach this goal. As such, we are focusing on conservation agriculture, defined as mineral disturbance combined with microorganisms in soils, as a more sustainable system of cultivation for the future.

Application of immunostimulators for pig-breeding without the use of antibiotics
b-Glucan, an endogenous polysaccharide immune-stimulator, exhibits high adjuvant activity in domestic breeding animals. It is one of the relatively few non-toxic, non-pyrogenic, water-soluble immune-stimulators. We have discovered that b-glucan has an immune-enhancing effect on pigs both as an adjuvant and as a non-specific immune-stimulant. As such, further investigation into isolating and characterizing new biological agents as immune-modulators should continue in view of this success.

Search for industrially useful microbial resources derived from Korean traditional fermented foods
We have studied the functional effects of Korean-style fermented foods such as kimchi, soy sauce, etc. Traditional Korean fermented foods promote good digestion, because the consumption of a cup of clear soup containing soy sauce enhances the secretion of gastric juice in human beings. Fermented soy sauce contains three tartaric isoflavone derivatives called soy flavones. These soy flavones were shown to have inhibitory activities against histidine decarboxylase, which produces histamine, a mediator of inflammation, allergy and gastric acid secretion. Soy sauce also exhibits anti-platelet activity. Beta-Carbolines were isolated from soy sauce as the active compounds. Soybeans and wheat, the main raw ingredients of soy sauce, are allergenic foods.

Development of a high-intensity sweetener using waste citrus peel
High-intensity sweetener, a low-calorie, full-bulk natural sugar was recently accorded GRAS (Generally Recognized As Safe) status under the U.S. Food and Drug Administration (FDA) regulations, thereby permitting its use as a sweetener in foods and beverages. We have studied the development of NHDC produced from citrus peel waste with regard to its demonstrated food and beverage applications, and the potential health and medical benefits of this unique substance. NHDC has been found to be safe and efficacious for use as a low-calorie, full-bulk sweetener in a wide variety of foods, beverages, health foods, and dietary supplements. It fills broad, hitherto unmet needs for a low-calorie sweetener in products whose bulk sugar content is important, such as chocolate, chewing gum, cakes, ice cream, and frosted cereals. Its synergism with other sweeteners also makes it useful in various foods. The various health and medical benefits of NHDC have been indicated, including the treatment of type 2 diabetes, hyperglycemia, anemia, and hemophilia, and the improvement of fetal development.

SELECTED PUBLICATIONS

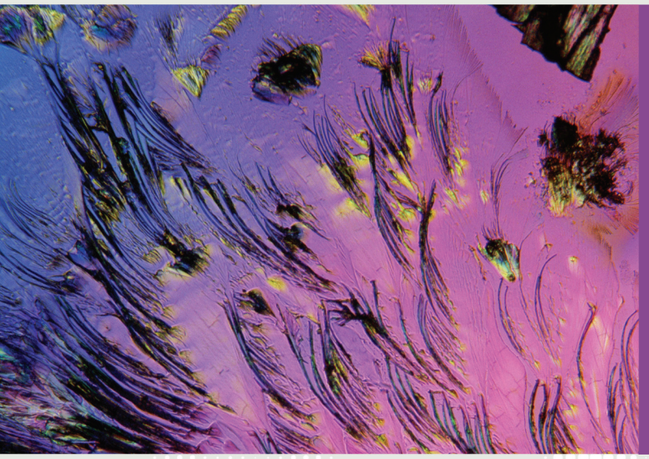
Min Soo Kim (Corresponding) *Anal Biochem.* 397(2):259-61.
Activity assay for nisin-like acidic bacteriocins using an optimal pH-conditioned gel matrix

Min Soo Kim (Corresponding) *Biotechnol Bioproc Eng.* 15(3):446-52.
Expression and identification of a minor extracellular fibrinolytic enzyme (Vpr) from *Bacillus subtilis* KCTC 3014

Min Soo Kim (Corresponding) *Biotechnol Lett.* 32(1):137-42.
Production of pure beta-glucan by *Aureobasidium pullulans* after pullulan synthetase gene disruption

Joong Su Kim (Corresponding) *Microbiol Res.* 165(5):384-91.
Purification and characterization of a novel glucansucrase from *Leuconostoc lactis* EG001

Division of National Agenda Projects



Viral Infectious Disease Research Center

AI Control Material Research Center

We pursue a better world by conducting basic and translational research designed to prevent influenza viruses, such as Avian influenza, and to develop new vaccines and antivirals based on our biotechnology research.

Viral Infectious Disease Research Center

RESEARCHERS

Haryoung Poo haryoung@kribb.re.kr
- Development of a new vaccine adjuvant and study of its mechanism
- Development of new candidates for universal vaccines

Jeong-Ki Kim jkim@kribb.re.kr
- Evaluation of the efficacy of newly developed vaccines in animal models
- Evaluation of the efficacy of the vaccine adjuvant in animal models
- Surveillance and genetic characterization of influenza viruses circulating in our circumstance

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

Doo-Jin Kim joongsu@kribb.re.kr
- Development of universial influenza vaccines
- Study on mucosal immune system and development of mucosal vaccines

RESEARCH AREAS

- Development of new vaccine technologies including subunit, DNA, and universal vaccines against viral infectious diseases
- Development of a new vaccine adjuvant for influenza vaccines, using polymer (poly-gamma-glutamate) nano-particles, together with investigation of the immune mechanism of the adjuvant
- Basic research on influenza pandemics, including surveillance and genetic characterization studies of influenza viruses and antiviral strategies

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 sub-types 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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ACHIEVEMENTS

Development of new vaccine technologies, including subunit, DNA, and universal vaccines, against current and future pandemic influenza viruses
Several candidates of subunit vaccines have been developed via prokaryotic and eukaryotic protein expression systems, using the H1 HA of a of the recent pandemic influenza A (H1N1) 2009 virus. We have succeeded in the mass production of highly pure HA proteins for use as antigens on vaccination and have currently evaluated their efficacies as vaccine candidates in animal models.

Development of a new vaccine adjuvant for influenza vaccines, using polymer (poly-gamma-glutamate) nano-particles, and the investigation of the immune mechanism of the adjuvant
As an efficacious vaccine adjuvant candidate, we have developed nano-particles conjugated with poly-gamma-glutamate, which induced a high level of NK cell-mediated cytotoxicity and IFN-γ secretion in a mouse model in our previous study. Study of the immune mechanism of the adjuvant has revealed that it strongly induces both humoral and cellular immune responses. The *in vivo* efficacy evaluation of the polymer nano-particle adjuvant has been completed in various animal models using a pandemic influenza A (H1N1) vaccine; the polymer nano-particle adjuvant was able to increase the vaccine efficacy much higher than the existing adjuvants, such as alum and squalene-based adjuvants.

Basic research on pandemic influenza, including surveillance and genetic characterization studies of influenza viruses and antiviral strategies
We have isolated influenza viruses from fecal samples of wild migratory birds (mainly ducks) on a regular basis. We have completely identified the positive isolates and have genetically and pathogenically characterized them. In addition, we have evaluated i*n vitro* and *in vivo* activities of some candidates of antiviral agents.

SELECTED PUBLICATIONS

Haryoung Poo (Corresponding) *Cancer Immunol Immunother.* 59(11):1727-37.
Human papillomavirus type 16 E6-specific antitumor immunity is induced by oral administration of HPV16 E6-expressing *Lactobacillus casei* in C57BL / 6 mice

Haryoung Poo (First) *Chem Biodivers.* 7(6):1555-62.
New biological functions and applications of high-molecular-mass poly-gamma-glutamic acid

Haryoung Poo (Corresponding) *Cell Prolif.* 43(6):584-93.
Identification of tyrosine-nitrated proteins in HT22 hippocampal cells during glutamate-induced oxidative stress

Jeong-Ki Kim (First) *Proc Natl Acad Sci U S A.* 107(24):11044-9.
Puzzling inefficiency of H5N1 influenza vaccines in Egyptian poultry

AI Control Material Research Center

RESEARCHERS

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

Mun-Chual Rho rho-m@kribb.re.kr
- Identification of inflammation related target molecules and establishment of screening systems for inflammation related diseases
- Isolation and structure elucidation of active compounds

Young-Min Kim u9897854@kribb.re.kr
- Development of solubilized process of active compounds and mass production
- Enzymatic modification of infection and inflammation related target molecules

Su-Jin Park sjpark@kribb.re.kr
- Isolation and bulk culture of viruses (Coronavirus, Rotavirus, Influenzavirus, etc) and genetic and phylogenic analysis of isolated viruses
- Pathologic, immunohistochemical, electron microscopic studies using animals

Young Bae Ryu ybryu@kribb.re.kr
- Isolation and identification of secondary metabolites from natural resources
- Identification of infection related target molecules and establishment of screening systems for infection related diseases

RESEARCH AREAS

Construction of bioassay systems related to infectious diseases
- Establishing bioassay and screening systems for compounds against infectious diseases (virus, bacteria and malaria)
- Developing specifically active compounds such as inhibitors of neuraminidase to combat the avian influenza virus

Construction of bioassay systems related to inflammatory diseases
- Establishing bioassay and screening systems for compounds against inflammatory diseases (pneumonia, asthma, arthritis, etc.)
- Developing specifically active compounds such as inhibitors of cell adhesion molecules, cytokines and chemokines

Construction of a natural product fraction library
- Constructing and utilizing both a fraction from plant and microbial culture extracts and a natural compound library

Our aim is to develop functional foods, natural feeds and therapeutic materials against infectious diseases (virus, bacteria and malaria) and inflammatory diseases (pneumonia, asthma, arthritis, etc.) from the natural product library, starting with traditional medicines.

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ACHIEVEMENTS

Identification of biomaterials for infectious and inflammatory diseases
Influenza viruses bind to sialic acid on the host cell surface 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 the cell can support virus replication, and (2) the virus particles themselves have sialic acid incorporated into their surface glycoproteins, so potentially virus particles will bind to each other. Neuraminidase promotes influenza virus release from infected cells and facilitates virus spread within the respiratory tract. And, cell adhesion molecules (ICAM-1/LFA-1, VCAM-1/VLA-4), cytokines and chemokines, participate in cell to cell interaction that is important in the progression of the inflammatory response in diseases such as pneumonia, asthma and others. Therefore, we have developed active biomaterials from natural resources using in vitro assay systems and related infectious and inflammatory diseases, and obtained bioactive compounds from selected biomaterials by chromatographic techniques.

Identification of new molecular targets related to infectious and inflammatory diseases
Through research of molecular targets such as proteomics and genomics, new target candidates of inflammatory and viral infectious diseases have been identified. We established assay/screening systems for inflammation and virus related diseases.

***In vitro* and *in vivo* antiviral evaluations**
We established the identification of cultures and quantitative titration methods for several viruses including the influenza virus, rotavirus, coranvirus, rhinovirus and enterovirus, and developed new active biomaterials and immunotherapies against viruses, utilizing virology, mechanisms of action, *in vitro* activity and animal models.

Natural product fraction library
To compile a natural product fraction library, we are collecting plant resources and utilizing plant extracts through open column chromatography and a natural product library.

SELECTED PUBLICATIONS

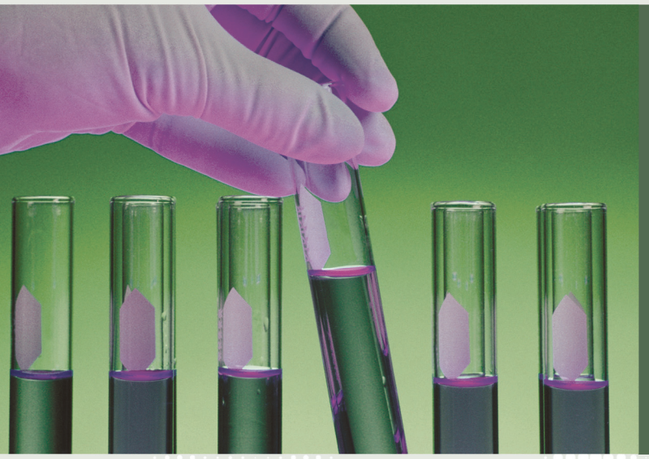
Su-Jin Park & Woo Song Lee (Co-corresponding) *Bioorg Med Chem.* 18(21):7668-74.
In vitro anti-rotavirus activity of polyphenol compounds isolated from the roots of *Glycyrrhiza uralensis*

Mun-Chual Rho & Woo Song Lee (Co-corresponding) *Bioorg Med Chem.* 18(22):7940-7.
Bisflavonoids from *Torreya nucifera* displaying SARS-CoV $3CL^{pro}$ inhibition

Mun-Chual Rho & Woo Song Lee (Co-corresponding) *Bioorg Med Chem Lett.* 20(6):1873-6.
SARS-CoV $3CL^{pro}$ inhibitory effects of quinone-methide triterpenes from *Tripterygium regelii*

Su-Jin Park (Co-corresponding) *Vet Microbiol.* 144(3-4):274-86.
Detection and genotyping of Korean porcine rotaviruses

Biotechnology R&D Infrastructure



Korean Bioinformation Center
World Class Institute
International Biological Material Research Center
DAEJEON-KRIBB-FHCRC Research Cooperation Center
Biotech Policy Research Center
Korea Biosafety Clearing House
Microbial Genomics & Applications Center

Sharing Biotech Value by Expanding Bio-Infrastructure and Providing Information Support

To enhance the public biosafety awareness, contribute to the growth of the bioindustry and extend the benefits of biotechnology to broader segments of society, KRIBB supplies the latest information on biotech policies in Korea and worldwide through its information-sharing network. KRIBB also procures biomaterials not available in Korea, from overseas resources, and distributes them to industry and academia.

Korean Bioinformation Center

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- Bioinformatics of genome and proteome
- Alternative splicing and microRNA

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- Processing NGS data
- gene expression analysis and epigenomic regulation

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- Biomedical informatics
- Systems cancer biology

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- Development of Korean Bio-resource Information System (KOBIS)
- Systems biology and chemoinformatics

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- De novo assembly and integrative analysis of genomes
- Genome mutation analysis with expression, phenotype, and disease
- Genome variation analysis and their evolutionary studies
- Genomics research via comparative genomics approaches

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- Gene expression data analysis and knowledge discovery
- Systems biology through network approach

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- Protein structure modeling.
- Chemo-informatics research.

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- Evolution of proteomes, functomes, and metabolomes
- Phylogenomics of transcriptomes for ontogenetic divergence

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- Modeling signal pathways and gene regulatory network
- Machine learning and computational statistics with application to molecular biology
- Computational systems biology approach in cancer biology

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- Development of Korean Bio-Resource Information System
- Text Mining
- Bio-Cloud Computing
- NGS Data Compression and Delivery

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- Statistical analysis of the DNA microarray experiment
- Statistical analysis of the NGS experiment
- Multivariate analysis

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- Manual curation and interpretation of bioinformatics data
- Expression signature for metastasis

RESEARCH AREAS

Genome Informatics Team
- De novo assembly and integrative analysis of genomes
- Genome mutation analysis with regard to expression, phenotypes, and diseases
- Genome variation analysis and their evolutionary studies
- Genomics research via comparative genomics approaches

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 and biodiversity information from various research labs and institutions across the country. KOBIC provides a centralized data access portal to promote data sharing and utilization among research groups.

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RESEARCH AREAS

Expression and Regulation Team
- Development of analysis pipelines and core algorithms for RNA-sequencing
- Construction of analysis pipelines for epigenome and small RNA data

Biomedical Informatics Team
- Development of databases and systems for microarray data analysis
- Development of integrated analysis systems for cancer genome data

Systems Bioinformatics Team
- Integration of biological networks and annotation of information
- Development of algorithms, tools, and DBs for systems bioinformatics

Structural Informatics Team
- Protein structure modeling (homology modeling)
- Structure determination with experimental observables (NMR, X-ray)
- Development of algorithms, tools, and DBs for structural informatics

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

Information Service Team
- Improvement and preservation of web-service system
- Development of service item

Computer System Team
- Development and management of servers, clusters, and storage systems
- Support for developing web-based solutions
- Implementation of CLOUD computing infrastructure

ACHIEVEMENTS

In an effort to support bioinformatics and genomics research in Korea, we develop numerous bioinformatics algorithms and applications, with emphases on (i) Next Generation Sequencing (NGS), (ii) systems bioinformatics, (iii) biomedical informatics, and (iv) structural informatics. The resulting pipelines and knowledgebases are provided to biologists and bioinformaticians to facilitate biological interpretation of OMICS data, especially the large-scale genomics data. In addition, we actively participate in many international collaborative projects for research and education.

SELECTED PUBLICATIONS

Byungwook Lee (Corresponding) *BMC Genomics.* 11(Suppl 4):S20.
Gerontome: a web-based database server for aging-related genes and analysis pipelines

In-Sun Chu (Co-corresponding) *Hum Mutat.* 31(8):942-9.
Short rare *MUC6* minisatellites-5 alleles influence susceptibility to gastric carcinoma by regulating gene

In-Sun Chu (Corresponding) *J Clin Oncol.* 28(16):2660-7.
Expression signature of *E2F1* and its associated genes predict superficial to invasive progression of bladder tumors

World Class Institute (WCI)

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RESEARCH AREAS

Gene and protein identification for cancer control
- Breast cancer, skin cancer, hepatic cancer, prostate cancer and cervical Cancer

Discovery of new anticancer drug candidates
- Medicinal plants, micobial secondary metabolites, chemical libraries

Protein degradation in association with disease
- N-end rule pathway, endoplasmic reticulum stress

Epigenomic DNA regulation
- Cell division, DNA methylation and metastasis

Chemical Biology
- Protein target identification and in vivo, ex vivo application

WCI is composed of eight international researchers, eight Korean researchers and eight international collaborators. Until now, five postdoc fellow and Ph.D students are working at each collaborator's institutions. The aim of WCI is to discover four anticancer targets and therapeutic drug candidates. Each of the four groups - Cell and Molecular Biology Team, Structural Biology Team, Xenograft Animal Model Team and Chemical Biology Team is closely collaborating each other with their results. Director Dr. Raymond Leo Erikson from Harvard University leads and organizes most of the researches and global networks. After five years of the WCI program, this center will be one of the world-leading groups in cancer biology and cancer therapeutics development.

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ACHIEVEMENTS

- Human whole gene siRNA screening for discovery of cancer marker
- Human whole gene siRNA screening for discovery of N-degron associated genes
- Chemical biology for target identification and drug design
- Computational biology for HTS
- Generation of xenograft mouse model
- Osteoclast differentiation and cancer

International Biological Material Research Center (IBMRC)

RESEARCHERS

Hyouk Joung joungh@kribb.re.kr
- Director of International Biological Material Research Center
- Horticultural Science

Joongku Lee joongku@kribb.re.kr
- Plant taxonomy
- Biodiversity

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- Biodiversity
- Environmental Science

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- Plant taxonomy
- Biodiversity

Sang Woo Lee ethnolee@kribb.re.kr
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- Ethnobotany

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- Plant taxonomy
- Biodiversity

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- Plant taxonomy
- Biodiversity

RESEARCH AREAS

- Establishment 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 the scope of the assigned project
- Development of new natural drugs, nutraceuticals and other commercially important natural products

We are aiming at procuring indigenous 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 biodiversity of materials and ethno-botanical information, including indigenous medicinal knowledge and also to establish the nation's core infrastructure for developing new natural drugs and nutraceutical products, along with other commercially important natural products.

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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 100,000 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 Cumming, Yunnan
- Personnel (2 experts from Korea) and research equipment set up
- Biological materials: 8,940 dried plant species and extracts with ethnobotanical information

Central and South America
- Establishment of the Korea-Costa Rica Biological Material Research Center in Santo Domingo de Heredia, Costa Rica
- Personnel (1 experts from Korea) and research equipment set up
- Biological materials: 1,944 dried plant species and extracts with ethnobotanical information

South-East Asia
- Establishment of the Korea-Indonesia Biological Material Research Center
- Personnel (2 experts from Korea) and research equipment set up
- Biological materials: 2,051 dried plant species and extracts, including oceanic biological materials from Micronesia

Africa
- Signed an MOU with UNIKIN on "Establishment of KOREA-D.R. CONGO Biological Material Research Center (2010 August)
- Biological materials: 2,140 dried plant species and extracts with ethnobotanical information

SELECTED PUBLICATIONS

Joongku Lee (Co-corresponding) *Phytochem Lett.* 3(4):238-41.
Identification of novel fatty acid glucosides from the tropical fruit *Morinda citrifolia L.*

DAEJEON-KRIBB-FHCRC Research Cooperation Center

RESEARCHERS

Hyang-Sook Yoo yoohyang@kribb.re.kr
- Cancer genomics
- Cell cycle and signaling, yeast genetics and gene expression

Jeong-Heon Ko jhko@kribb.re.kr
- 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

Eun Wie Cho ewcho@kribb.re.kr
- Discovery of auto-antibody-based biomarkers that show changes in the serum of cancer patients

Yong-Sam Kim omsys1@kribb.re.kr
- Discovery of biomarkers that show changes in terms of both quantity (amount of protein in serum level) and quality (aberrant glycosylation), with highly positive prediction values
- Development of a biomarker validation method and validation of candidate cancer biomarkers
- Mechanistic study of cancer progression focused on glyco-oncoproteins

RESEARCH AREAS

- Discovery of biomarkers that show changes both in quantity and quality, with highly positive prediction values in gastric, liver, colon and lung cancers
- Functional studies that relate candidate biomarkers to the biology of a cancer
- The role of glycolipid in the apoptotic death of mammalian cells
- Discovery of auto-antibodies produced during the progression of a cancer as cancer biomarkers
- Identification of drug targets for use in the treatment of cancer patients

Our goal is to discover cancer biomarkers of high sensitivity and specificity that are useful for diagnosing and predicting cancers at the earliest possible stage and for monitoring the effects of drugs. In collaboration with the teams from the International Cancer Biomarker Consortium led by Dr. Lee Hartwell of the Fred Hutchinson Cancer Research Center, we focus on identifying biomarkers for the early detection of liver, stomach, colon and other cancers, which will help to treat cancer patients more effectively and efficiently, and ultimately raise the survival rate of cancer patients.

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ACHIEVEMENTS

Discovery and validation of candidate biomarkers for liver cancer
The multi-lectin approach was employed to mine liver cancer-specific serological Glycoproteins; 8 proteins were found to be identified only from the sera of HCC patients. The list of candidate HCC biomarkers was patented and will be validated for the narrowing down of good biomarkers. These candidate biomarkers are being validated using a DNAtagged antibody-based method.

Comparative quantitation of aberrant glycoforms by lectin-based glycoprotein enrichment coupled with multiple-reaction monitoring mass spectrometry
Lectin enrichment-coupled multiple-reaction monitoring (MRM) mass spectrometry was employed to quantitatively monitor the variations of aberrant glycoforms produced under pathological states. For this, dramatic variations in abundance of the aberrant glycoforms of TIMP-1 and PTPk due to overexpressed GnT-V was confirmed quantitatively by comparative MRM analysis of lectin-enriched samples, allowing comparatively quantitation of a protein of interest and its aberrant glycoform. This will be useful for studying pathological mechanisms of cancer and verifying biomarker candidates.

Identification of an anti-fatty acid synthase auto-antibody in the HCC mouse model and its application to the diagnosis of HCC
We reported the anti-fatty acid synthase (FASN) auto-antibody in hepatocellular carcinoma (HCC) using the HCC mouse model and suggested a novel method for the detection of anti-FASN auto-antibody in patient sera, which is very effective for the diagnosis of HCC.

SELECTED PUBLICATIONS

Yong-Sam Kim (Co-first) *Anal Chem.* 82(11):4441-7.
Comparative quantitation of aberrant glycoforms by lectin-based glycoprotein enrichment coupled with multiple-reaction monitoring mass spectrometry

Eun Wie Cho (Co-corresponding) *Biochem Biophys Res Commun.* 400(1):100-5.
SM22α-induced activation of $p16^{INK4a}$/retinoblastoma pathway promotes cellular senescence caused by a subclinical dose of γ-radiation and doxorubicin in HepG2 cells

Eun Wie Cho (Corresponding) *Int J Oncol.* 36(6):1453-9.
Identification of autoantibody against fatty acid synthase in hepatocellular carcinoma mouse model and its application to diagnosis of HCC

Hyang-Sook Yoo (Co-first) *Nat Biotechnol.* 28(6):617-23.
Analysis of a genome-wide set of gene deletions in the fission yeast *Schizosaccharomyces pombe*

Biotech Policy Research Center

RESEARCHERS

Byung Hwan Hyeon bhhyun@kribb.re.kr
- Director of the Biotech Policy Research Center, Commissioner of the National Science & Technology Council

Seong Hoon Moon shnb8@kribb.re.kr
- Policy planning and policy research, Analysis of industrial trends

Young Cheol Kim yckkr@kribb.re.kr
- Policy planning and policy research, Biotechnology white paper

Cheon Moo Lee leecm@kribb.re.kr
- Policy planning and policy research, Analysis of institutional trends related to bioethics and biosafety

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- Policy planning and Analysis of technological trends and patent Analysis

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- Policy planning and Analysis of technological trends and patent Analysis

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- Policy planning and Organizing expert Networks and monitoring BT information

Mi Jeong Park mj7252@kribb.re.kr
- Management of bioportal (i.e. BioIn) and the monitoring of BT information

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- Management of bioportal (i.e. BioIn) and knowledge resource systems (i.e. KR), PPT Design

Min-Jung Oh mjoh@kribb.re.kr
- Management of seminars, PR and public relations

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- Policy research, technological trends and patent Analysis

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- Management of budget and administration

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- Policy research, Analysis of industrial trends

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- Policy research, technological trends and patent Analysis

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- Policy research, technological trends and patent Analysis

Jae-Hyung Lee leejh@kribb.re.kr
- Policy research, technological trends and patent Analysis

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

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

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 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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ACHIEVEMENTS

Policy Planning
- Planning for the definition of the roles and responsibilities of the New Drug Development Support Center and designing a management model
- Strategy for strengthening the competitiveness of fundamental technology development programs and planning for the HT Acceleration Project
- Planning for the creation of a government-wide New Type Influenza Response Team

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 85,000 pieces of informational data.

Expert Network
- To operate the Korean Association of Biotechnology Research

International Collaboration
- To participate in the 26th / 27th Session of the OECD Working Party on Biotechology
- To participate in BAKAS 2010 Symposium and KRIBB-Kolis Symposium

Korea Biosafety Clearing House

RESEARCHERS

Homin Jang hmjang@kribb.re.kr
- Biosafety information management, especially in accordance with the Biosafety Protocol and the "Act on transboundary movements, etc. of LMO"

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- LMO Regulations and Biosafety information management

Byongchul Shin bcshin@kribb.re.kr
- CBD and Access to genetic resources and Benefit-Sharing(ABS) information management

Wonhee Kim whkim@kribb.re.kr
- LMO & Biosafety information management

Mihee Jeon mhjeon@kribb.re.kr
- Public awareness and participation on LMO & Biosafety

Jeongsuk Cho chojs@kribb.re.kr
- Collecting and survey information related on LMO

Gookche Jeon bobos302@kribb.re.kr
- Collecting and survey information related on Bioindustry

RESEARCH AREAS

The Biosafety Protocol & LMO Act Implementation
- Abiding by Information Duties
- Implementing Administrative Issues (Making out Country Reports, Analyzing major issues in COP-MOP, Operating Expert Forum about major issues, etc.)
- Support Developing Country's Capacity-Building
- Implementation of the LMO Act (Operation of Biosafety Committee, support operation of LMO Act's Scheme and its Improvement, etc.)

Improvement of Public Awareness & Communication
- Operation of Biosafety Korean and English Portals and family sites
- Publications of *The Biosafety Whitepaper, The Biosafety Journal*, etc.
- Host of communication activities (LMO forums, international seminars, biosafety essays, debate competitions, etc.)

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

Korea Biosafety Clearing House (KBCH) specializes in public awareness & communication, survey and research, international cooperation and in abiding by legal requirements concerning LMO which is needed for the implementation of the "Cartagena Protocol on Biosafety" and the "Act on Transboundary Movements, etc. of LMO"

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 which professionally carries out matters concerning the management and exchange of the information on Living Modified Organisms (LMO).

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ACHIEVEMENTS

Compliance with the LMO Law and the Biosafety Protocol

The KBCH began carrying out its official role as a legal organization in January 2008, although it had actually worked on related issues for the preceding six years. The KBCH's primary mission is to undertake those duties mandated by the LMO Law and the Biosafety Protocol regarding the information on the transfer, handling and use of LMOs. Its mission largely consists of the collection and distribution of accurate information on LMOs, the promotion of public awareness of LMOs and participation in related matters. Over the past three years, the KBCH has handled approximately 10,700 national LMO cases including import approvals for LMOs-FFP (food and feed, and for processing), facilities reports, etc. The KBCH has discharged its obligation to disclose all of the collected information to the public by various means, such as the internet, media and in printed form.

Improvement of Public Awareness and Participation

To promoting awareness and participation, especially with the public, the KBCH does its utmost to be an indispensable element for assuring biosafety, as stipulated in the Protocol. Above all, the KBCH conveys to the public both the positive and negative aspects of LMOs, so public discussion concerning LMOs are conducted based on facts. To this end, it operates the national "Biosafety Potal", participated in discussions on high-profile private internet sites such as "Agora" on DAUM and "Knowledge IN" on NAVER, etc.; and distributed 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 the hosting of seminars (LMO forum, etc.), which anyone can attend and share their opinions, and the "Biosafety Essay Competition" and "Biosafety Debate Competition" for middle and high school students which attracted many applicants this year.

OTHER ACTIVITIES

The KBCH offers its services to the Ministries responsible for LMOs issues.

The KBCH holds meeting on a regular basis with government officials. The KBCH also cooperates with international LMO organizations. The KBCH has staged events, such as the UNEP-KBCH co-sponsored seminar in Daejeon in 2008, and is scheduled to co-host the 2nd UNEP-KBCH seminar in 2011, which is held to assist developing countries build capacity of LMO information. In recent years, the KBCH has held regular information sharing meeting with Japan and is now exploring the possibility of similar cooperation with China and India. The KBCH participated in ABS Protocol negotiations as a member of the Korean delegation in 2010. After adoption of the ABS Protocol (Nagoya Protocol), the KBCH is currently preparing an ABS information portal and HelpDesk to support bioindustry.

Microbial Genomics & Applications Center

RESEARCHERS

Tae Kwang Oh otk@kribb.re.kr
- Microbial Enzymology
- Director of Microbial Genomics and Applications Center

JiHyun F Kim jfk@kribb.re.kr
- Microbial Genomics
- Bacteria-host interaction

Jung Hoon Yoon jhyoon@kribb.re.kr
- Biodiversity
- Metagenome

Myung Hee Kim mhk8n@kribb.re.kr
- Protein structure and function
- Macromolecular crystallography
- Mechanism of signaling by histidine kinase

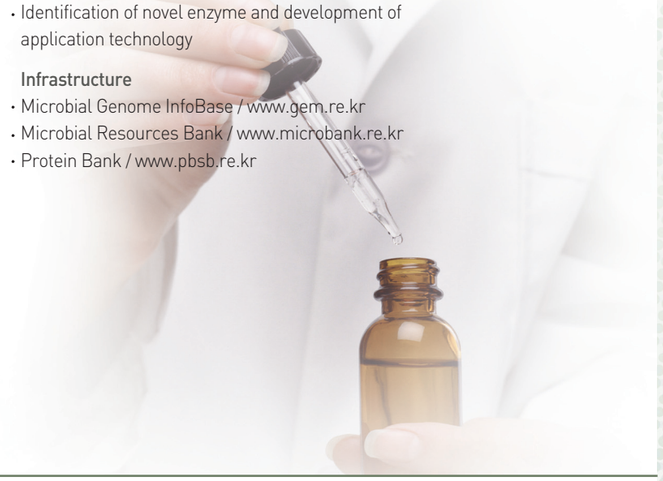
RESEARCH AREAS

Microbial diversity and metagenomes
- Screening of extremophiles and interaction microbes
- Development of isolation and screening techniques for uncultivated microbes
- Screening of goal-directed and beneficial microbes
- Metagenome analysis and beneficial gene screening
- Analysis of viral metagenomes and development of beneficial genes

Integrated functional analysis of microbial genomes
- Genomic network of model systems
- Regulatory network of interactive microbes
- Applications of microbial interactions
- Redesign of metabolic circuits
- Microbial technological convergence
- Future technologies for bioenergy
- Microbial protein structure and function

Industrial application of microbial genomes
- Development of fermentation and bioprocessing technologies based on cell reengineering
- Development of highly functional enzyme
- Investigation of novel physiological active materials
- Platform biomaterial development suitable for genome reengineering
- Synthetic biology-based novel biomaterial development
- Identification of novel enzyme and development of application technology

Infrastructure
- Microbial Genome InfoBase / www.gem.re.kr
- Microbial Resources Bank / www.microbank.re.kr
- Protein Bank / www.pbsb.re.kr



We aim to promote the discovery of novel genes, valuable biomolecules, engineered microbes and innovative bioprocesses. The Microbial Genomics and Applications Center focuses on developing technology platforms to utilize information about genome function obtained from analyses of microbial genomes isolated from diverse environments.

- To elevate Korea to one of the top countries in the world microbial industry
- To create a market exceeding a billion dollars
- To construct global knowledge infrastructure by acquiring key intellectual property rights

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ACHIEVEMENTS

We developed highly efficient Xylitol production process by genomic reconstruction in *Candida tropicalis* (KAIST) and developed *Corynebacterium glutamicum* amino acid producing strain and bioprocess for low cost /high yields /high productivity using Genome-based cell reconstruction technology (CJ Co., Ltd), and developed the production method for a novel xylitol dehydrogenase and L-xylulose using the some enzyme. (Konkuk Univ.)

We unveiled the early stage of bacterial genome-reductive evolution in the host (Korea Univ.) for the first time (publically available through PLOS Patohgens) and it may represent the key component of a general mechanism for early bacterial evolution in the host.

We developed the cell-free expression method of Membrane domain structures and rapid NMR analysis (publically available through Proceedings of the National Academy of Sciences) at the Korea Basic Science Institute.

International Cooperation Department

Technology Transfer Office

Support for Knowledge Information

International Cooperation Department

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Opening of World Class Institute (WCI)

With the opening of the World Class Institute in December 2009, KRIBB established a global research center for Kinomics-based anti-cancer development at the Ochang Campus and started joint research. The WCI project, supported by the Ministry of Education, Science and Technology, was started to attract leading researchers at home and abroad to conduct joint research, thereby enhancing the global competitiveness of Korean government-funded research institutions.

Through the Global Open Innovation networks, 13 domestic and foreign institutions, including Harvard University and MIT, and 22 researchers have been conducting joint research to discover Kinomics-based anti-cancer target proteins and drug candidates. The center appointed Dr. Raymond L. Erickson from Harvard University as the head of the organization and conducts research for the discovery of causal genes and their roles in breast and skin cancers.

Overseas Research Center

KRIBB operates research cooperation centers on bio-material in the three foothold countries of China, Indonesia, and Costa Rica, and signed an MOU with the University of Kinshasa of Congo in August 2010 to build the Korea-DR Congo Biological Material Research Center. It has also opened and has been operating the Korea-Hungary Joint Laboratory at the Enzymology Institute of the Hungarian Academy of Sciences(HAS) since October 2010, and the Biotechnology Joint Research Center to Combat Desertification at the Institute of Soil and Water Conservation (ISWC) of China and KRIBB as well.

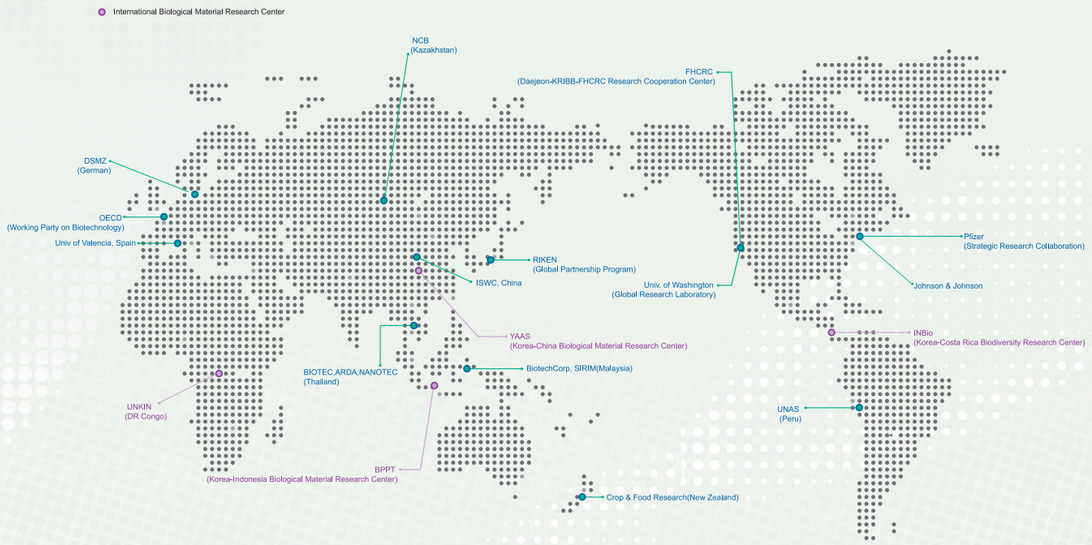
Strategic Partnership with Leading Global Businesses

KRIBB is the first institute in Korea to collaborate with Pfizer to conduct joint research to develop optimum therapeutic target genes for liver and stomach cancer. At the same time, it has been developing household product technologies in cooperation with Johnson & Johnson through the discovery and commercialization of potential phytonutrient by utilizing natural extracts.

Bio-Experts Development Program in Biotechnology

At the request of the Malaysian government, KRIBB operated a bio-experts development program for Malaysian university biotechnology majors, who were recommended by the Malaysian government, for two months. As an exemplary cooperation program to enhance the partnership between Korea and Malaysia in bio-industry, the program was conducted for 8 weeks, focusing on the theory and practice of bio-industrial process technologies. Ten industrial experts from KRIBB joined the program and 8 students recommended by the Malaysian government completed the course.

In June 2010, KRIBB provided training programs for the employees of the Agricultural Research Development Agency (ARDA) of Thailand, on the practical aspects of technology management through Intellectual Property Rights management and micro-organism management. During the same period, at the Vietnam Institute of Ecology and Biological Resources, dignitaries of KRIBB shared Korea's advanced science, technology, and experiences through an invitational training session, thereby laying the groundwork for future cooperation between the two countries.



International Research Project List

Principal Investigator at KRIBB	Project Title	Period		Research Partner(s)
		Start	End	
Dr. Bong Hyun Chung	Development of materialls for one-spot multiple bioanalysis	2008-07-01	2018-06-30	The University of Kitakyushu, Japan
Dr. Jihyun F. Kim	An Integrated Information Bank for Microbial Genome Research	2002-10-01	2011-03-31	Auburn University, USA
Dr. Jung Hoon Yoon	Microbial Resources Bank	2002-10-01	2011-03-31	Yanbian University, China
Dr. Won-Gon Kim	Transcriptional regulatory mechanism of development and maintenance of Dopaminergic neurons : Anovel therapeutic target of Parkinson's Disease	2009-01-01	2011-12-31	Harvard University, USA
Dr. Eun Wie Cho	Identification of tumor-associated antibodies/antigens and the development of cancer diagnostics	2009-01-01	2011-12-31	The Fred Hutchinson Cancer Research Center, USA
Dr.Kyou-Hoon Han	The role of pre-structured motifs (PreSMos) in the promiscuous interactions of intrinsically unfolded protein	2010-09-01	2013-08-31	Hungarian Academy of Sciences, Hungary
Dr. Myung Hee Kim	Proteome Bank	2009-04-01	2011-03-31	University of Southern California, USA
Dr.Inpyo Choi	Development of platform technology for cancer immunotherapy	2007-06-01	2016-03-31	University of Washington, USA
Dr. Choong-Min Ryu	Practical use of induced resistance compounds derived from endophytic and soil microorganisms	2007-01-01	2010-12-31	USDA-ARS, USA
Dr.Bo Yeon Kim	Global Research Center for Discovery of Cancer Targets and Chemotherapeutics Based on Kinomics	2009-12-01	2010-11-30	NIH, USA
		2009-12-01	2010-11-30	MIT, USA
		2009-12-01	2010-11-30	Harvard University, USA
Dr.Dae-Yeul Yu	Generaion of ENU mutant mice and studies on in vivo function of the mice	2005-12-16	2011-02-28	RIKEN, Japan Nanjing University, China
Dr. Jeong-Heon Ko	Institutional cooperation for cancer biomarker developemnt	2006-06-28	2011-06-30	Fred Hutchinson Cancer Research Center, USA
Dr. Jong-Seog Ahn	KRIBB-RIKEN Collaboration Research Center for Chemical Biology	2006-12-01	2012-08-31	RIKEN, Japan
Dr. Hyang-Sook Yoo	Therapeutic Targets for Liver and Gastric Cancer	2009-03-20	2011-03-20	Pfizer, USA

Technology Transfer Office (TTO)

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Bridging the Gap between the Bioscience Innovation and the Real World Applications

The business development based on the technologies of KRIBB has been doing by the Department of Intellectual Property Management which is playing a role as a technology transfer office(TTO). The idea or know-how as well as the technologies developed from the R&D centers are detected by the Technology Evaluation Committee of KRIBB run by the TTO of KRIBB, and their market and business values for creating new bioindustry are also assessed. The selected technologies are actively licensed out to market leaders including domestic and global companies. Nurturing and incubating start-ups are another important function of the TTO of KRIBB. The joint venture with established partner company could be created by providing with highly valued technology.

Main Functions

- **Knowledge (Intellectual) Property Management : Making a strong patent**
  Consulting of intellectual property filling/office action/maintenance
  Screening of excellent idea/know-how/technology
  Scientific affairs to internal and/or external collaboration

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

- **Business Incubation**
  Creating new startups/joint ventures (Institute Enterprise)
  Arranging fund investment for spin-off KRIBB companies
  Incubating biotech. start-ups at BioVenture Center (BVC)

- **Creating the Joint-Venture, MiCoBioMed, Inc. (2nd Institute Enterprise)**
  Company type : The Joint Venture (Institute Enterprise)
  Partner Company : KoMiCo, Inc. (KOSDAQ company)
  Technology base : Biochip and Bionano-sensor technology from Bionanotechnology Research Center (Dr. Bong Hyun Chung)
  Market area : Biosensor market, Diagnostic Market

Support for Knowledge Information

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Information Collection and Current Status

The KRIBB Digital Library(http://library.kribb.re.kr) has made it a priority to collect electronic materials such as electronic journals, electronic books, and web databases for providing information more rapidly and improving users' convenience. The library has been subscribing to electronic journals since 1998 and participating in the KESLI consortium. At the moment, the number of electronic journals to which the library subscribes is 5,300 titles, which is much higher than their 47 printed journals. More than 400,000 articles are downloaded in PDF or HTML format each year.

Information		No. of Material	Major Sources
Journals	Printed journals	469	Currently 47 journals are subscribed to and 16,499 volumes are bound
	Electronic journals	5,300	17 publishers including ACS, Elesevier, Nature, OUP, Springer, Wiley
Books	Printed books	13,900	Research books or reference materials
	Electronic books	5,028	Elsevier, netLibrary, Springer, Wiley
Research reports		6,423	KRIBB and other institutes
Market trend reports		730	Datamonitor, Frost & Sullivan
Video materials		200	KBS Media
Web databases		7	CCD, Delphion, JCR, SciFinder, Scopus, Springer Protocols, TradiMed
Software		3	ChemBioOffice, EndNote, ezPDF

Research Results and Information Databases

The library has databased KRIBB's research results on the web with 6,889 papers, 1,549 patents, 1,510 research reports, and 420 presentations (Total: 10,368) for web users. By using the iLIPS program, users can search and gain access to all data including printed books, electronic journals, and electronic books within the library.

Document Delivery Service (DDS)

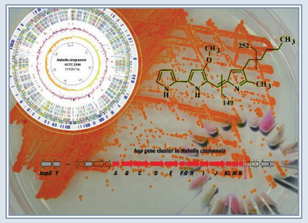
To solve the problems of the increasing amount of information and the lack of collections in the library, the library has made agreements with the Korean Medical Library Association (KMLA), Korea Special Library Association (KSLA), National Digital Science Library (NDSL), and Korea Education and Research Information Service (KERIS) so that researchers can obtain copies of original materials. The library has provided more materials (1,890 items) than it has received requests for original copies (1,682 items), which means that it has contributed to promoting document delivery among domestic libraries.

Management of Papers and Laboratory Notebooks

In deciding on promotions and assessing personal performance, every paper published by researchers has been managed with a special program (MIS) according to the criteria for paper assessment. The program is used for registering and inputting papers, building a full-text database, checking SCI and IF, issuing statistical data, reporting the results in and out of the KRIBB, providing a service for web users, and publishing references(SCI reference materials, vol. 8, in Aug.).
We manage the whole process related to laboratory notebooks - from requests and issuance to taking over - by implementing the management program (685 notebooks were issued in 2010). We promote laboratory notebook recording, and assist in establishing a proper research culture by running educational courses regularly. In line with this policy, we redeveloped the Electronic Laboratory Notebook (KRIBB-ELN) system this year.

APPENDICES

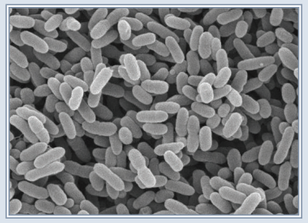
OUTSTANDING RESEARCH ACHIEVEMENTS



1. IDENTIFIED A MECHANISM TO ADJUST BIOSYNTHESIS OF RED TIDE-KILLING SUBSTANCE

Researcher Dr. Jihyun F. Kim I February 2010

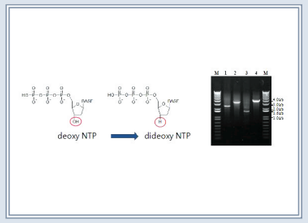
The biosynthesis adjustment mechanism of prodigiosin was successfully identified, which is a substance produced by Hahella Chejuensis, a marine microbe that is separated from the Marado Island. The substance also kills red-tide plankton species. Through functional genetic analysis, the research team found a gene that controls biosynthesis, and the adjustment mechanism using molecular genetic techniques. Among 50 or so clones with genes that involve in the biosynthesis of prodigiosin, the team discovered the fact that signal transduction which is composed of two proteins is important to adjustment of prodigiosin's biosynthesis; one is sensor proteins that recognize the external environmental conditions and the other is proteins that transduce the signal to a gene expression system. It also proved that adjustment by non-coding RNA, which has not been widely known, plays a critical role to biosynthesis of pigment.



2. FOUND A NEW COMMERCIALLY USEFUL MICROBE

Researcher Dr. Jae Jun Song I March 2010

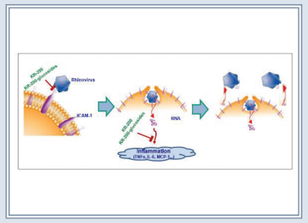
A new commercially useful bacteria was found and published in the International Journal of Systematic and Evolutionary Microbiology, a world-renowned British academic journal in the microbial ecology, after naming it as "Jeongeupia Naejangsanesis." In particular, while studying some commercially useful enzymes from renewable biomass, the research team separated a new strain with excellent cellulose degrading activity from soil of the Mt. Naejang, in Jeongeup, Jeonbuk. The strain, Jeongeupia naejangsanensis, which was named after the place it was discovered, was officially approved around the world.



3. DEVELOPED A NEW GENOME WALKING TECHNIQUE TO SECURE USEFUL GENES

Researcher Dr. Jung Hoon Sohn I April 2010

Template-blocking PCR, a genome-walking technique that can use PCR to secure various useful genes with unknown genome information in a fast and accurate way, was developed to discover cellulose degrading enzyme gene, which is critical in the green bioenergy sector. The technique made it possible to extract cellulose degrading gene from Korea's native cellulose degrading fungi. It was a gene that can produce cellulase, which is essential in the bioenergy production process. Currently, cellulase is recombined and produced in large quantities by using beer yeast, and it is being applied to researches for bioethanol production.



4. DEVELOPED NATURAL SUBSTANCE TO TREAT THE COLD

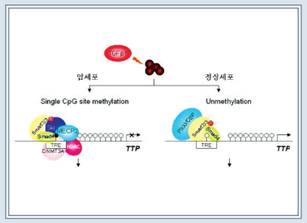
Researcher Dr. Mun-Chual Rho I April 2010

"KR-200" and "KR-200-glucoside," biomaterials that have an excellent anti-virus effect against the cold virus and a treatment effect against inflammation caused by virus infection were developed. They were applied for domestic and overseas patents, and the core technology related to them was transferred at KRW 10 billion for license fee. The two biomaterials were separated from herbal extracts and fractions, and have an excellent anti-virus effect against rhinovirus and coxsackievirus, the common cold viruses. At the same time, they were proven to have some treatment effects against inflammation by controlling various inflammatory factors caused by viral infection.

5. SECURED SYSTEMATIC RESEARCH MATERIAL OF NATIVE PLANTS IN THE KOREAN PENINSULA

Researcher Dr. Joong-Ku Lee I April 2010

"The Illustrated Guide to the Seeds of Wild Plants in Korea" shows an external form and fine structure of seeds of 1,048 Korea's native plants, collected by 70 or so participating researchers from the mountains and fields for the past decade. The book is systemized to allow easy identification of the form and features of seeds, while providing standardization for each seed form that is linked to another plant. The published illustrated book is also published as E-book and can be easily searched and read through its website (http://www.seedbank.re.kr).



6. IDENTIFIED ACTION PRINCIPLE OF THE ACCELERATION OF LIVER CANCER

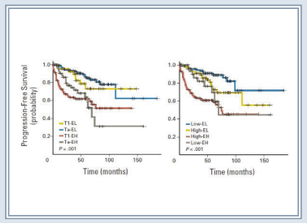
Researcher Dr. Young Il Yeom I May 2010

It was identified how the signal transduction of TGF_, an anti-carcinogenic substance that controls cancer, accelerates the cancer in the liver cancer case. A new mechanism demonstrates how TGF_, the substance that patients with liver cancer usually secrete in large amount, accelerates the spread of cancer although it is an anti-carcinogenic bioactive material (cytokine).
The research team found the existence of a uniquely formed molecular switch (CpG switch), which is used when TGF_ expresses TTP gene. Also, it proved that the switch is paralyzed due to DNA methylation, so that it made the cell come to have resistance to a cancer suppression function of TGF_. It results in converting the function of TGF_'s signal transduction pathway from cancer-suppressing mode to cancer- accelerating one.

7. ESTABLISHED THE WORLD'S FIRST YEAST LIBRARY AND DEVELOPED A SYSTEM TO RESEARCH DRUG ACTION

Researcher Dr. Kwang-Lae Hoe I May 2010

A yeast library was established, securing 5,000 strains of mutants that only one of the genes is removed from yeast, and a system was developed to allow the search by microarray. The research result was published on the on-line Nature Biotechnology on May 16, 2010. Through the development of the new system and study using the yeast library, the research team discovered 500 strains of new cancer-related genes for the first time in the world, and is currently identifying a new action mechanism.

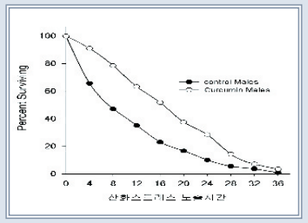


8. DISCOVERED GENE COMPLEX RELATED TO PROGRESSION AND PROGNOSIS OF BLADDER CANCER

Researcher Dr. In-Sun Chu I May 2010

A new gene expression pattern, which can discern progression and prognosis of bladder cancer, was identified using genome and bioinformatics technique. The research team studied expression patterns of entire genes using DNA chip which were put in 233 bladder tissue samples, including tumor samples of 165 bladder cancer patients. As a result, it discovered core gene complex, which are closely related to progression of prognosis of bladder cancer, and provided the grounds for new diagnostic technique.

OUTSTANDING RESEARCH ACHIEVEMENTS



9. IDENTIFIED LIFE EXTENSION AND AGING CONTROL OF CURCUMIN

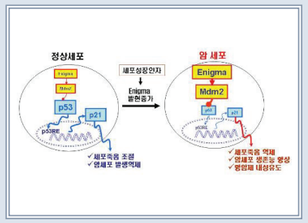
Researcher Dr. Kweon Yu I July 2010

Drosophila is used to prove that curcumin suppresses aging and reduces expression of genes that accelerate aging. Vinegar flies that ate curcumin lived 20% longer on an average than the control group, and exhibited greater health life as aging-retrogression was reduced. It was found that the first fly group has more resistance to various environmental stresses than their control group, and the group extended their lives by changing the expression of aging-related genes.

10. DEVELOPED POPLAR IMMUNE TO ENVIRONMENTAL STRESS

Researcher Dr. Sang-Soo Kwak I September 2010

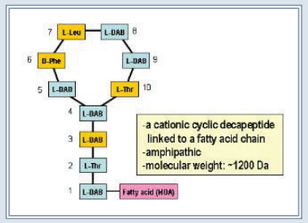
Eco-friendly trait-converting poplar, which is immune to environmental stresses and can grow in domestic and overseas areas with unfriendly condition for growing, was developed. The SN poplar that converts trait showed tolerance to oxidative stress in the LMO Δ¯¿Â proliferation process by the Korea Forest Research Institute. On top of this, it exhibited the effect of accelerating growth and development by facilitating activation of auxin synthetic gene, a plant growth hormone. It is expected to allow obtainment of Certified Emission Reduction and purification of soil in the polluted areas through increased biomass when planting them in areas with unfriendly condition for growing in Korea and overseas, such as desertification area, polluted area, etc in the future.



11. SUPPRESSED PROLIFERATION OF CANCER CELL WHEN REDUCING EXPRESSION OF "ENIGMA"

Researcher Dr. Dong-Soo Im, Cho-Rok Jung I November 2010

It was first discovered that enigma, one of the proteins in the cell, influences the proliferation of cancer cells, results in increasing resistance to anticancer medicines. The research team found that enigma and Mdm2 in the liver and stomach cancer tissues exist at the same location in the cancer cell, and that the more enigma and Mdm2 exist, the less p53 becomes. For cancer cells that have more expressed enigmas, cancer continuously proliferates even when administering Adriamycin, an anticancer medicine. However, the team proved, in a mice tumor model, that blocking the expression of enigma significantly reduced the proliferation of cancer cell.



12. DEVELOPED CORE TECHNIQUE FOR THE NEXT-GENERATION ANTIBIOTIC BY DECODING GENOME OF USEFUL MICROBE

Researcher Dr. Seung-Hwan Park I November 2010

"Polymyxin," a biosynthetic genome, was identified for the first time in the world through a genome function study of "Paenibacillus polymyxa," a germ useful to plants. Along with this, the research team laid a core foundation for development of agricultural materials, such as eco-friendly microbe pesticide and fertilizer, as it secures many genes, which facilitate growth and development of plants, and control pathogenic bacterium harming plants from the same germ.

The team discovered genetic information that synthesizes polymyxin biosynthesis enzyme from paenibacillus genome, and successfully produced a trait converting body of bacillus subtilis, which produces polymyxin, using synthetic biology technology. This helped the team to establish the foundation for effective development and production of new antibiotics, while obtaining US patent for the related techniques.

13. SIGNIFICANTLY IMPROVED THE PRECISION FOR CALCULATION OF GENE DOSAGE

Researcher Dr. Sanghyuk Lee I November 2010

A new analysis technique, called NEUMA (Normalization by Expected Uniquely Mappable Area), was developed. The newly developed technology greatly improved the precision when calculating gene dosage from mass sequence data which was generated from the Next Generation Sequencing (NGS) method. In a bid to overcome the limitations that the existing Cufflinks or TopHat methods have, NEUMA measured gene dosage using the already known RAN information. It is a state-of-the-art technology that significantly improved the precision of the gene dosage measurement from NGS data that are generated in a massive volume. It is also a core technique that can advance an era of future medicine that is based on personal genome information.

14. BEAN LEAF EXTRACTS FOUND TO BE EFFECTIVE IN FIGHTING OBESITY AND IMPROVING BLOOD CIRCULATION

Researcher Dr. Tae-Sook Jeong I December 2010

The research team has completed application for patents in Korea and overseas for compound for prevention and treatment of metabolic syndrome (including obesity, hyperlipidemia, atherosclerosis, and diabetes) of bean leaves and bioactive materials extracted from bean leaves. The team imported model animals for arteriosclerosis (LDLR-/- mouse) and ran a test for twelve weeks. As a result, animals in which bean leaf extracts were injected (1% of content weight among feed) showed a signification reduction of accumulation of lesion in the aorta and of sticking of macrophage, a major factor that causes arteriosclerosis. Also, it exhibited less accumulation of fat in the liver tissue and liver cell, which was resulted in prevention of arteriosclerosis and a fatty liver.

15. DEVELOPED MATERIALS TO PREVENT RED COLORING AND ROOT ROT OF GINSENG AND BIOACTIVE MATERIALS

Researcher Dr. Young-Kook Kim I December 2010

A research team found bioactive materials and prevention materials against red coloring and root rot of ginseng, which have been the cause of reducing their product value. The team developed B-4228, a new strain of bacillus subtilis, which impedes growth and development of trichoderma viride and production of red pigment by penicillium purpurogenum, which causes of red coloring of ginseng, along with a red-coloring prevention compound that contains the new strain.

LIST OF PATENTS REGISTERED OVERSEAS

Title of Patent	Investors	Date	Country
Method for the diagnosis of cancers by measuring the changes of glycosylation of proteins related to tumorigenesis and metastasis and kit for diagnosis of cancers using the same	**Dr. Jeong-Heon Ko et al.**	2010.11.5	Japan
Flavonoid comprising antiviral activity	**Dr. Dur Han Kwon et al.**	2010.9.10	Russia
Agent for prevention and treatment of cancer comprising oxadiazole urea compound obstructing activity of STAT	**Dr. Byoung-Mog Kwon et al.**	2010.9.21	U.S.A
Composition comprising extract of Phellinus sp. PL3 or Phellinsin A isolated from the same as an effective component for prevention and treatment of cardiac circuit disease	**Dr. Sung Uk Kim et al.**	2010.11.23	U.S.A
Inden derivatives and process for the preparation thereof	**Dr. Seung Jun Kim et al.**	2010.2.19	Japan
Inden derivatives and process for the preparation thereof	**Dr. Seung Jun Kim et al.**	2010.6.22	U.S.A
Agent for killing insects comprising compounds having ACYL CoA: Cholesterol acyltransferase inhibitory or salt thereof	**Dr. Young-Kook Kim et al.**	2010.9.10	Japan
The transformed plant cell expressing tandem repeats of •, -amyloid gene and plant produced by the same	**Dr. Hyun Soon Kim et al.**	2010.4.20	U.S.A
Novel 2-oxo-azepine derivative compound and the pharmaceutical composition containing the same for treating cancer disease	**Dr. Hwan Mook Kim et al.**	2010.5.25	U.S.A
Polymixin synthase and gene cluster thereof	**Dr. Seung-Hwan Park et al.**	2010.10.12	U.S.A
Method of protein synthesis	**Dr. Jae Gu Pan et al.**	2010.8.31	U.S.A
Vector for anti-HPV vacine and Transformed Microorganism by the vector	**Dr. Haryoung Poo et al.**	2010.7.16	Japan
Composition for Adjuvant Containing Poly-gamma-glutamic acid	**Dr. Haryoung Poo et al.**	2010.5.27	Russia
Rapid screening method of suitable translational fusion partners for producing recombinant proteins	**Dr. Jung Hoon Sohn et al.**	2010.11.3	Germany
Rapid screening method of suitable translational fusion partners for producing recombinant proteins	**Dr. Jung Hoon Sohn et al.**	2010.11.3	France
Rapid screening method of suitable translational fusion partners for producing recombinant proteins	**Dr. Jung Hoon Sohn et al.**	2010.11.3	U.K
Preparation of monoclonal antibody to N-myc downstream regulated gene 2 and determination of NDRG2 using protein chip	**Dr. Eun Young Song et al.**	2010.5.18	U.S.A
Method for Recombinating Plastid Using Prcaryotic Recombinase Gene	**Dr. Jang Ryol Liu et al.**	2010.3.12	Japan
Hansenula polymorpha yapsin deficient mutant strain and process for the preparation of recombinant proteins using the same	**Dr. Hyun Ah Kang et al.**	2010.9.8	U.K
Hansenula polymorpha yapsin deficient mutant strain and process for the preparation of recombinant proteins using the same	**Dr. Hyun Ah Kang et al.**	2010.9.8	Germany
Hansenula polymorpha yapsin deficient mutant strain and process for the preparation of recombinant proteins using the same	**Dr. Hyun Ah Kang et al.**	2010.9.8	Netherlands

Title of Patent	Investors	Date	Country
Fluorescent indicator proteins having increased signal intensity to concentration of sugars and use thereof	**Dr. Seung Goo Lee et al.**	2010.4.30	Japan
Method for cloning and expressing target gene by homologous recombination	**Dr. Seung Goo Lee et al.**	2010.8.27	Japan
Extract of ogalpi, Erectile dysfunction fanning healthy food and erectile dysfunction treating agent containing the same	**Dr. Jung Joon Lee et al.**	2010.5.26	China
Extract of ogalpi, Erectile dysfunction fanning healthy food and erectile dysfunction treating agent containing the same	**Dr. Jung Joon Lee et al.**	2010.5.26	U.S.A
Inden derivatives and process for the preparation thereof	**Dr. Jeong-Hyung Lee et al.**	2010.5.26	China
Inden derivatives and process for the preparation thereof	**Dr. Jeong-Hyung Lee et al.**	2010.5.26	Japan
Inden derivatives and process for the preparation thereof	**Dr. Jeong-Hyung Lee et al.**	2010.5.26	Mexico
Inden derivatives and process for the preparation thereof	**Dr. Jeong-Hyung Lee et al.**	2010.5.26	U.S.A
Agastache rugosa extract and composition containtng tilianin isolated and purified from said extract having anti-antherogenic activity	**Dr. Hyeong-Kyu Lee et al.**	2010.6.22	Canada
Pharmaceutical composition comprising anextract of pseudolysimachion longifolium and the catalpol derivatives isolated therefrom having antiinflammatory, antiallergic and antiasthmatic activity	**Dr. Hyeong-Kyu Lee et al.**	2010.5.6	Australia
A composition comprising an extract of Tiarella polyphylla and tiarellic acid isolated therefrom having anti-inflammatory, anti-allergic and anti-asthmatic activity	**Dr. Hyeong-Kyu Lee et al.**	2010.7.27	U.S.A
Translational Elongation Factor Promoter from Pichia Pastoris and Method for Producing Recombinant Protein Using the Same	**Dr. Hong-Weon Lee et al.**	2010.10.19	U.S.A
Novel abietane diterpenoid compound, and composition comprising extract of torreya nucifera, or abietane diterpenoid compounds or terpenoid compounds isolated from them for prevention and treatment of cardiovascular disease	**Dr. Tae-Sook Jeong et al.**	2010.10.26	U.S.A
Novel abietane diterpenoid compound, and composition comprising extract of torreya nucifera, or abietane diterpenoid compounds or terpenoid compounds isolated from them for prevention and treatment of cardiovascular disease	**Dr. Tae-Sook Jeong et al.**	2010.11.2	U.S.A
Method for screening of a lipase having improved enzymatic activity using yeast surface display vector and the lipas	**Dr. Eui Sung Choi et al.**	2010.3.24	China
Method for screening of a lipase having improved enzymatic activity using yeast surface display vector and the lipas	**Dr. Eui Sung Choi et al.**	2010.9.28	India
Method for screening of a lipase having improved enzymatic activity using yeast surface display vector and the lipas	**Dr. Eui Sung Choi et al.**	2010.9.28	India
Differentiation regulating agent containing gene which regulating differentiation from stem cell to natural killer cell effective ingradient	**Dr.InPyo Choi et al.**	2010.7.14	China

LIST OF RESEARCH PROJECTS

MEST	Ministry of Education, Science and Technology	ME	Ministry of Environmemt
MKE	Ministry of Knowledge Economy	KFS	Korea Forest Service
MIFAFF	Ministry for Food, Agriculture, Forestry and Fisheries	CBTP	ChungBuk Techno Park
MIHWAF	Minister for Health, Welfare and Family Affairs	DJTP	Daejeon Techno park

Project Title	Manager	Fund	Period
Integrated healthy tree management system for heathy tree by microbe and natural materials as elicitors of the plant immunity	**Dr. Choong-Min Ryu**	DJTP	06.01.2010-02.28.2011
Studies on the molecular markers of cancer metastasis using quantitative proteomics and immuno-proteomics	**Dr. Sung Hyun Kang**	MEST	05.01.2010-04.30.2011
Development of a dedifferentiation-accelerating technology using epigenetic system-modifying proteins	**Dr. Yong-Kook Kang**	MEST	08.01.2010-07.31.2011
Mechanistic studies and antibody therapeutic application of CTHRC1, a novel factor expressed in cancer cells	**Dr. Sang Seok Koh**	MEST	11.01.2010-10.31.2011
Institutional cooperation for cancer biomarker developemnt	**Dr. Jung-Heon Koh**	MEST	07.01.2010-06.30.2011
Development and application of the drought tolerant plants for combating desertification	**Dr. Sang-Soo Kwak**	MEST	12.28.2010-12.27.2011
Operation of the for Korea-China Biothchnology Collaboratioon Research Center on Combating Desertification	**Dr. Sang-Soo Kwak**	MEST	12.28.2010-12.27.2011
Identification of new physiological substrates of the TRIM E3 ligase and their roles in musculoskelectal differentiation	**Dr. Ki-Sun Kwon**	MEST	05.01.2010-04.30.2011
Spatio-temporal Bio-imaging of calcium signaling system	**Dr. Ki-Sun Kwon**	MEST	04.01.2010-03.31.2011
Study on the redox-mediated cell shgnaling network	**Dr. Ki-Sun Kwon**	MEST	08.01.2010-07.31.2011
Mode of actions of candidates in biological systems with genomic and proteomic tools	**Dr. Byoung-Mog Kwon**	MEST	04.01.2010-03.31.2011
Strategic Planning for Development of the Global Anti-Cancer Drug Based on Cinnamon Compound	**Dr. Byoung-Mog Kwon**	MEST	12.15.2010-07.14.2011
Development of metagenome expression and genetic enzyme screening system	**Dr. Ohsuk Kwon**	MEST	08.01.2010-07.31.2011
Development of molecular biological tools for the strain improvement of succinic acid producing Mannheimia succiniciproducens	**Dr. Ohsuk Kwon**	MEST	04.01.2010-03.31.2011
Study of two-component signal transduction system of the methylotrophic yeast Hansenula polymorpha	**Dr. Ohsuk Kwon**	MEST	05.01.2010-04.30.2011
Epigenetic regulation study of ZNF312b, novel target of gastric cancer	**Dr. Nam Soon Kim**	MEST	05.01.2010-04.30.2011
Proteome Bank	**Dr. Myung Hee Kim**	MEST	04.01.2010-03.31.2011
Development of Cell Multi-patterning Technology Based on Photoreactive Water-soluble Polymers	**Dr. Min-Gon Kim**	MEST	07.01.2010-06.30.2011
Development of microreactor-type optical biosenser for diagnosis and monitoring	**Dr. Min-Gon Kim**	MEST	07.01.2010-06.30.2011
Global Research Center for Discovery of Cancer Targets and Chemotherapeutics Based on Kinomics	**Dr. Bo Yeon Kim**	MEST	12.01.2010-11.30.2011
Identifaction funcional exploitation of genes regulating ingibition of ionizing radiation-induced ER-stress	**Dr. Bo Yeon Kim**	MEST	04.01.2010-03.31.2011
Experimental validation of potential anti-cancer drug targets identified by minig cancer gene expression database	**Dr. Seon-Young Kim**	MEST	05.01.2010-04.30.2011
Determination of the regulatory mechanisms for Heterochronic pathway	**Dr. Sunhong Kim**	MEST	05.01.2010-04.30.2011
Structural and functional studies of eyes absent	**Dr. Seung Jun Kim**	MEST	05.01.2010-04.30.2011
Medical informatics infrastructure for diabetes melitus genomics	**Dr. Young Ju Kim**	MEST	05.01.2010-04.30.2011
Monitoring and in-depth analysis of aberrant glycoproteins as cancer biomarkers using mass spectrometry	**Dr. Yong-Sam Kim**	MEST	07.10.2010-07.09.2011
A Study on National Genomic Research Strategy	**Dr. Yong-Sung Kim**	MEST	04.01.2010-09.17.2010
Study on Inhibitors of New Anti-mycobacterial Target, Enoyl-ACP Reductase	**Dr. Won-Gon Kim**	MEST	05.01.2010-04.30.2011
Development of new antibacterial compounds using microbial genomics	**Dr. Won-Gon Kim**	MEST	03.01.2010-03.31.2011
Biocompatible dendrimer-based contrast agents for the diagnosis of cancer using PET/SPECT imaging	**Dr. Yoon Kyung Kim**	MEST	05.01.2010-04.30.2011
An Integrated Information Bank for Microbial Genome Research	**Dr. Jihyun F. Kim**	MEST	04.01.2010-03.31.2011
Production of stilbene compounds with anti-viral and anti-inflammatory activity in microbes and plants	**Dr. Cha Young Kim**	MEST	05.01.2010-04.30.2011
Exploitation of endophytic microbial resources from plant	**Dr. Chang jin Kim**	MEST	10.01.2010-09.30.2011
Exploitation of microbial diversity under extreme and rhizosphere environment	**Dr. Chang jin Kim**	MEST	04.01.2010-03.31.2011
Development of industrial enzymes for biorefinery	**Dr. Chul Ho Kim**	MEST	02.01.2010-03.31.2011
Functional analysis of 3-hydroxypropionic acid synthesis enzyme derived from Lactobacillus sp.	**Dr. Chul Ho Kim**	MEST	05.01.2010-04.30.2011
Evaluation of efficacy and pharmacokinetics of molecular target specific anticancer drug candidates and validation of molecular targets	**Dr. Hwan Mook Kim**	MEST	11.15.2010-11.14.2011
Development of disease model mouse using proton beam	**Dr. Ki Hoan Nam**	MEST	05.01.2010-03.31.2011
Study of virus infection-inflammation regulatory bio-material based on cell adhesionmolecule and cytokine	**Dr. Mun-Chul Rho**	MEST	04.01.2010-03.31.2011
Airborne resistance elicitation in plants : intra- and interspecific communication	**Dr. Choong-Min Ryu**	MEST	05.01.2010-04.30.2011
Understanding signaling transduction/ production technique of bacterial secondary metabolite	**Dr. Choong-Min Ryu**	MEST	04.01.2010-03.31.2011
Functional analysis of the pathogen-associated molecular patterns and effector of Burkholderia glumae causing bacterial grain rot in rice and the development of the disease control methods by the surveillance mechanism of rice to the pathogen	**Dr. Jae Sun Moon**	MEST	04.01.2010-03.31.2011
Identification of PAUL as a novel therapeutic target for cancer	**Dr. Kyung Chan Park**	MEST	05.01.2010-04.30.2011
Proteomic analysis for factors and its reaction mechanisms related on age-specific cancers and immune diseases	**Dr. Byoung Chul Park**	DJTP	08.16.2010-07.31.2011
Study of co-regulation of disease specific metabolome with proteome and genome	**Dr. Sung Goo Park**	MEST	04.01.2010-03.31.2011
Development of bio-contents and on-chip kits for MS-based diagnosis	**Dr. Sung Sup Park**	MEST	07.01.2010-06.30.2011
Construction of fully human monoclonal antibody for the treatment of Lung cancer	**Dr. Youngwoo Park**	MEST	06.01.2010-05.31.2011

LIST OF RESEARCH PROJECTS

Project Title	Manager	Fund	Period
Development of fully human antibodies and Receptor fusion proteins for Rheumatoid Arthritis.	**Dr. Youngwoo Park**	MEST	11.15.2010-11.14.2011
Epigenetic control of plant defense responses against viral pathogens	**Dr. Jeong Mee Park**	MEST	09.01.2010-08.31.2011
Development of high active xylanase from insect microbes	**Dr. Ho-Yong Park**	MEST	04.01.2010-03.31.2011
System development for application of genomic sequence information	**Dr. Hong-Seog Park**	MEST	08.01.2010-07.31.2011
Functional roles of annexin family on NF-kB activity and its involvement in diseases	**Dr. Kwang-Hee Bae**	MEST	05.01.2010-04.30.2011
Development of cellulolytic yeast complex for consolidated bioprocess	**Dr. Jung Hoon Sohn**	MEST	03.01.2010-02.28.2011
The Functional study and evaluation of Tescalcin(TESC) in cancer	**Dr. Eun Young Song**	MEST	05.01.2010-04.30.2011
Development of High-Throughput Screening Technology for Enzyme Mining on the Basis of HTS Robot System	**Dr. Jae Jun Song**	MEST	08.01.2010-07.31.2011
Characterization of nanoimprint technology based on nano-phtoelectronic devices	**Dr. Yong Beom Shin**	MEST	04.01.2010-03.31.2011
Construction for foreign plant extract library	**Dr. Kyung-Seop Ahn**	MEST	10.01.2010-09.30.2011
Construction of Polyketide Biosynthetic Diversity and Screening of Bioactive Microbial Metabolite.	**Dr. Jong-Seog Ahn**	MEST	04.01.2010-03.31.2011
KRIBB-RIKEN Collaboration Research Center for Chemical Biology	**Dr. Jong-Seog Ahn**	MEST	10.01.2010-08.31.2011
Modelling the genetic network of calcium metabolism by DNA microarray-based gene expression analysis	**Dr. Young Il Yeom**	MEST	04.01.2010-03.31.2011
Development of Molecular Imaging Technology for Glycan Marker	**Dr. Doo Byoung Oh**	MEST	05.01.2010-04.30.2011
Development of preclinical candidates against asghma and chronic inflammai on using foreign plants	**Dr. Sei-Ryang Oh**	MEST	12.01.2010-09.30.2011
Project for the Management of MGAC program	**Dr. Tae Kwang Oh**	MEST	04.01.2010-03.31.2011
Development of large-scale CO2 fixation and biodiesel production technology using improved microalgae.	**Dr. Hee-Mock Oh**	MEST	04.01.2010-03.31.2011
Determination of SMART antibody mechanism and Structure-Based Antibody Design for Nano-Diagnostics	**Dr. Eui Jeon Woo**	MEST	07.01.2010-06.30.2011
Structural and functional study on glycogen debranching enzyme to determine the bi-functional mechanism and its application	**Dr. Eui Jeon Woo**	MEST	05.01.2010-04.30.2011
Development of novel HIF-1a inhibitors for treatment of cancer	**Dr. Mi Sun Won**	MEST	11.15.2010-11.14.2011
Control of insulin signaling by the neuropept ide and ER stress	**Dr. Kweon Yu**	MEST	09.01.2010-08.31.2011
Functional analysis of the short neuropeptide F signaling for regulating metabolic syndrome	**Dr. Kweon Yu**	MEST	03.01.2010-02.28.2011
Generaion of ENU mutant mice and studies on in vivo function of the mice	**Dr. Dae-Yeul Yu**	MEST	03.01.2010-02.28.2011
A study on the Biological resource management for Bioeconomy	**Dr. Jang Ryol Liu**	MEST	12.15.2010-05.14.2011
Development of Cyanocrop by utilizing photosynthetic Syanobacterial genes	**Dr. Jang Ryol Liu**	MEST	04.01.2010-03.31.2011
Discovery and development of domestic novel and useful biological resources	**Dr. Jong Hoon Yoon**	MEST	04.01.2010-03.31.2011
AnMicrobial Resources Bank	**Dr. Jong Hoon Yoon**	MEST	04.01.2010-03.31.2011
Development of Neutron Image-Plate Camera(Bio-C) Beamline for Three-Dimensional Structure-Based Bio-Nano Research	**Dr. Tae Sung Yoon**	MEST	05.01.2010-03.31.2011
The functions of Drosophila insulin-like peptides in growth and metabolism	**Dr. Gyu Sun Lee**	MEST	05.01.2010-04.30.2011
Pulmonary/Intravenous siRNA Delivery System for Lung Cancer Therapy	**Dr. Myung Kyu Lee**	MEST	07.01.2010-06.30.2011
Integration System on National Biological Resource and Genome Information	**Dr. Byung Wook Lee**	MEST	04.01.2010-03.31.2011
Differentiation control of human mesenchymal stem cell via targeting on the regulation network of Protein tyrosine phosphatases	**Dr. Sang Chul Lee**	MEST	08.01.2010-07.31.2011
High-throughput Affinity Screening Technology	**Dr. Seoung Goo Lee**	MEST	03.01.2010-02.28.2011
Development of biomaterial for virus infection control	**Dr. Woo Song Lee**	MEST	04.01.2010-03.31.2011
Management for the Application of Bio R&D Products (Bioresources)	**Dr. Jung Sook Lee**	MEST	04.01.2010-03.31.2011
Development of cell line with multiple transgenes for xenotransplantation	**Dr. Jeong Woong Lee**	MEST	06.01.2010-05.31.2011
Construction of Herbarium and Information Data Base with Foreign Biological Materials	**Dr. Joongku Lee**	MEST	10.01.2010-09.30.2011
Infra-establisment and Support of Metabolic Syndrome Animal Models for Mitochondrial Function -regulation Researches	**Dr. Chul-Ho Lee**	MEST	08.01.2010-07.31.2011
Development of biological products for monitoring bio-medical function using high sensitive biosystems	**Dr. Hee Gu Lee**	MEST	04.01.2010-03.31.2011
Development of somatic cell clone monkey	**Dr. Kyu-Tae Chang**	DJTP	04.01.2010-03.31.2011
Establishment of neuroprotective strategies in the primate model	**Dr. Kyu-Tae Chang**	MEST	05.01.2010-04.30.2011
Development of the evaluation indicators for radiation response from radiosensitive genes	**Dr. Kyung-Sook Chung**	MEST	03.01.2010-02.28.2011
Study for epigenetic regulation, protein modification, and crosstalk of Rho proteins in cancer development	**Dr. Kyung-Sook Chung**	MEST	05.01.2010-04.30.2011
Elucidation of phosphorylation mechnism of a novel mitochondrial PTP-MT1 and development of potential drugs for type 2 diabetes by structural studies	**Dr. Dae Gwin Jeong**	MEST	05.01.2010-04.30.2011
Design, purification and production of highly sensitive and stable L-Glutamate oxidase	**Dr. Bong Hyun Chung**	MEST	07.01.2010-06.30.2011
Development of Novel Switch Molecules for Molecular Diagnosis and Imaging	**Dr. Bong Hyun Chung**	MEST	03.01.2010-02.28.2011
Development of protein chip-based bioassay system and biological contents for protein chip applicaion	**Dr. Bong Hyun Chung**	MEST	06.01.2010-05.31.2011
Planning and management of protein chip technology research project	**Dr. Bong Hyun Chung**	MEST	06.01.2010-05.31.2011
Development of Bio-system for Optimization of Label Free Molecular Imaging Technology	**Dr. Sang Jeon Chung**	MEST	08.01.2010-07.31.2011
Production and application of biomolecules for bio-electronical devices.	**Dr. Yongwon Jung**	MEST	04.01.2010-03.31.2011
Development of new therapeutics on atherosclerosis via the combination of ACAT inhibitors and modulators of bile acid synthesis	**Dr. Tae-Sook Jeong**	MEST	03.01.2010-02.28.2011

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Project Title	Manager	Fund	Period
Research on the mechanism of proton beam-induced mutagenesis and prospects of its applications	**Dr. Hae Young Jeong**	MEST	04.01.2010-03.31.2011
The establishment and management of foreign biological resources center	**Dr. Hyouk Joung**	MEST	10.01.2010-09.30.2011
Development of cancer diagnostics using tumor-associated autoantibodies	**Dr. Eun Wie Cho**	MEST	09.01.2010-08.31.2011
Development of Bcl-2 family inhibiting anti-cancer therapeutics based on a novel apoptsis pathway.	**Dr. Seung Wook Chi**	MEST	09.01.2010-08.31.2011
Development of Bacillus expression system using mRNA stabilizer	**Dr. Soo Keun Choi**	MEST	04.01.2010-03.31.2011
Synthetic biology for the biological production of hydrocarbon biofuel	**Dr. Eui Sung Choi**	MEST	04.01.2010-03.31.2011
Development of platform technology for cancer immunotherapy	**Dr. InPyo Choi**	MEST	04.01.2010-03.31.2011
Funtional analysis of VDUP1 as a drug target	**Dr. InPyo Choi**	MEST	07.16.2010-07.15.2011
Development of Industrial Host-Vector System based on metagenomic Resources	**Dr. Jong Hyun Choi**	MEST	05.01.2010-04.30.2011
Development of nanostructured surface for hyper-sensitive detection of toxic environmental substances	**Dr. Tai Hwan Ha**	MEST	08.16.2010-07.31.2011
Development of zero-reference nanostructure for one-tip multicomponent nano-inking system in the dip-pen nanolithography	**Dr. Tai Hwan Ha**	MEST	05.01.2010-04.30.2011
Target identification and characterization of molecular mechanism for biologically active chemicals.	**Dr. Dong Cho Han**	MEST	04.01.2010-03.31.2011
Development of Deposit and Application Systems for Biological Data	**Dr. BoKyeng Hou**	MEST	04.01.2010-03.31.2011
Development of a interpretation system for gene-regulatory networks in plant pathogens	**Dr. Cheol Goo Hur**	MEST	04.01.2010-03.31.2011
The international tomato chromasome 2 sequencing project and functional \analysis for solanaceae genomes	**Dr. Cheol Goo Hur**	MEST	04.01.2010-03.31.2011
A Study on the OECD WPB-related Activities	**Dr. Byoung Hwan Hyun**	MEST	02.10.2010-02.09.2011
Research on establishing advancement plan through an in-depth 3P analysis of BT	**Dr. Byoung Hwan Hyun**	MEST	04.01.2010-10.31.2010
Supporting Program for Policy & Information of Biotechnology	**Dr. Byoung Hwan Hyun**	MEST	07.01.2010-06.30.2011
Technologies of a reconstruction of biosynthetic pathway for modification of benwoquinone ring of geldanamycin	**Dr. Young Soo Hong**	MEST	04.01.2010-03.31.2011
Discovery of anticancer drug candidate modulating endoplasmic reticulum stress	**Dr. Bo Yeon Kim**	MIHWAF	06.01.2010-05.31.2011
Establishment of treatment and predictive markers in gastric carcinoma through high-throughput validation of amplified and me	**Dr. Seon-Young Kim**	MIHWAF	06.01.2010-05.31.2011
Regulation of metastasis via validation of a novel mode of action of transcription factor ZEB2	**Dr. Semi Kim**	MIHWAF	06.01.2010-05.31.2011
Studies on molecular targets related with hepatocellular carcinoma and metabolic disease induced by HBV X protein	**Dr. Dae Yeul Yu**	MIHWAF	06.01.2010-05.31.2011
The novel molecular mechanism for Non Alcoholic fatty liver disease and Hepatocellular carcinoma	**Dr. Cho-Rok Jung**	MIHWAF	05.01.2010-04.30.2011
Structural basis for p53 rescue from mdm2 by SUSP4	**Dr. Kyon Hoon Han**	MIHWAF	05.01.2010-04.30.2011

Project Title	Manager	Fund	Period
Development of salt tolerant bioenergy crops by utilizing salt-inducible genes from marine cyanobacteria	**Dr. Jang Ryol Liu**	MLTM	01.01.2010-12.31.2010
Fusion technology to control aging for the extended healthy life	**Dr. Ki-Sun Kwon**	MEST	07.01.2010-06.30.2011
Brassica crop improvement network	**Dr. Hye Ran Kim**	MEST	11.01.2010-11.30.2010
Development of cell control technology for the regeneration of aged tissues	**Dr. Doo Byoung Oh**	MEST	07.01.2010-06.30.2011
Development of Cellulose-based Biofuel Technology	**Dr. Seoung Goo Lee**	MEST	12.15.2010-12.31.2011
Development of peptide affinity chromatography for antibody purification	**Dr. Sang Jeon Chung**	MEST	11.15.2010-11.14.2011
The role of pre-structured motifs (PreSMos) in the promiscuous interactions of intrinsically unfolded protein	**Dr. Kyon Hoon Han**	MEST	09.01.2010-08.31.2011
Production of goat cloned embryos for TPO manufacturing	**Dr. Yong-Kook kang**	MIFAFF	06.25.2010-06.24.2011
Development of new variety and useful genetic resource using mutation breeding techniques	**Dr. Suk Yoon Kwon**	MIFAFF	12.20.2010-12.19.2011
Functional Genomics for Abiotic Stress in Cabbages	**Dr. Suk Yoon Kwon**	MIFAFF	07.01.2010-06.30.2011
Bioinformatics discovery and application of Brassica elite line specific genes	**Dr. Nam Shin Kim**	MIFAFF	05.01.2010-04.30.2011
Development of an Integrated Portable DNA Analysis Microsystem for On-site Verification of Korean Cow Originality	**Dr. Min-Gon Kim**	MIFAFF	04.10.2010-04.09.2011
Development of high potency ginseng products for prevention of metabolic diseases	**Dr. Bo Yeon Kim**	MIFAFF	06.25.2010-06.24.2011
Genome analysis and application of the thermotolerant yeast KM	**Dr. Jihyun F. Kim**	MIFAFF	07.01.2010-06.30.2011
Development of monitoring method for GM oilseed rape and bentgrass	**Dr. Chang-Gi Kim**	MIFAFF	04.10.2010-04.09.2011
Development of hairy vetch inoculant and green manure technology for reclaimed land	**Dr. Chang jin Kim**	MIFAFF	07.01.2010-06.30.2011
Studies on bacterial quorum sensing system for the development of biocontrol agent	**Dr. Chang jin Kim**	MIFAFF	06.25.2010-06.24.2011
Cultivar registration of transgenic elite lines expressing TGEV and HBV antigen and development as edible vaccine	**Dr. Hyun Soon Kim**	MIFAFF	04.10.2010-04.09.2011
Development of antigen gene-transgenic plant against Dengue virus infection	**Dr. Hyun Soon Kim**	MIFAFF	12.20.2010-12.19.2011
Development of Tools and Integrated Database for Cabbages and Broccolis	**Dr. Hye Ran Kim**	MIFAFF	07.01.2010-06.30.2011
Development of defense triggers derived from natural product and metagenome against biotic and abiotic stresses	**Dr. Choong-Min Ryu**	MIFAFF	04.10.2010-04.09.2011
The development of the certification technique for the crop breeding resistant to viral diseases	**Dr. Jae Sun Moon**	MIFAFF	04.10.2010-04.09.2011
Development of microbial insecticides using insect-pathogenic fungi	**Dr. Ho-Yong Park**	MIFAFF	06.01.2010-05.31.2011
Development of saccharification enzymes for bioenergy production from agricultural byproducts	**Dr. Ho-Yong Park**	MIFAFF	07.01.2010-06.30.2011
Development of cost-effective production system for recombinant cellulase	**Dr. Jung Hoon Sohn**	MIFAFF	06.25.2010-06.24.2011
Thermotolerant yeast (KM) platform for the production of bioenergy and biomaterial from agricultural biomass	**Dr. Jung Hoon Sohn**	MIFAFF	07.01.2010-06.30.2011
Development of dandelion as an industrial crop producing natural rubber	**Dr. Beung Tae Ryu**	MIFAFF	04.10.2010-04.09.2011
Development of CMS introduced breeding line by asymmetric protoplast fusion	**Dr. Jang Ryol Liu**	MIFAFF	12.20.2010-12.19.2011

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Project Title	Manager	Fund	Period
Development of bioactive material for the preventive feed additive and treatment of avian influenza	**Dr. Woo Song Lee**	MIFAFF	12.20.2010-12.19.2011
SPF induction of miniature-pig and improvement of reproductivity of miniature-pig in the SPF facilities	**Dr. Kyu-Tae Chang**	MIFAFF	04.10.2010-04.09.2011
The development of brand eels and food additives to help strengthen the immune system in eel culture	**Dr. Hye Sun Cho**	MIFAFF	07.01.2010-06.30.2011
Improvement of insecticidal activity of bioinsecticide by using customized enzyme	**Dr. Soo Keun Choi**	MIFAFF	04.10.2010-04.09.2011
Development of high potency black ginseng products for therapeutic prevention of osteoporosis	**Dr. Bo Yeon Kim**	MIFAFF	12.20.2010-12.19.2011
Improvement of developmental potential of cloned pig embryos through modifying epigenetic states of specific genome targets	**Dr. Yong-Kook Kang**	MIFAFF	01.01.2010-12.31.2010
Development of transgenic potato/sweetpotato and forage crops with enhanced tolerance to multiple environmental stress	**Dr. Sang-Soo Kwak**	MIFAFF	01.01.2010-12.31.2010
Analysis of transcriptome in rose	**Dr. Suk Yoon Kwon**	MIFAFF	01.01.2010-12.31.2010
Development of marker-free transgenic crops	**Dr. Suk Yoon Kwon**	MIFAFF	01.01.2010-12.31.2010
Development of commercial rose cell lines and establishment of transformation system using useful small RNAs	**Dr. Suk Weon Kim**	MIFAFF	01.01.2010-12.31.2010
Acquisition, isolation and mass production of inhibitors for type III secretion system of phytopathogenic bacteria	**Dr. Sung Uk Kim**	MIFAFF	01.01.2010-12.31.2010
Development of environmental risk assessment technology for genetically modified agricultural microorganisms	**Dr. Sung Uk Kim**	MIFAFF	01.01.2010-12.31.2010
Development of biocontrol agent from bioactive compounds of microbial origin	**Dr. Chang Jin Kim**	MIFAFF	01.01.2010-12.31.2010
Development of functional food and bioresources related to anticancer using medicinal plants	**Dr. Mun-Chul Rho**	MIFAFF	01.01.2010-12.31.2010
Practical use of induced resistance compounds derived from endophytic and soil microorganisms	**Dr. Choong-Min Ryu**	MIFAFF	01.01.2010-12.31.2010
Development of inhibitors for type III secretion systems of phytopathogenic bacteria	**Dr. Jae Sun Moon**	MIFAFF	01.01.2010-12.31.2010
The broad application of newly invented chip technology and the national database of oligo-nucleotide chip for the diagnosis of plant viruses	**Dr. Jae Sun Moon**	MIFAFF	01.01.2010-12.31.2010
Development of bioinformatics tools for Isolation of useful promoter from Solanaceae genome information	**Dr. Jeong Mee Park**	MIFAFF	01.01.2010-12.31.2010
Glycan analysis for the recombinant vaccines and therapeutic proteins expressed in plants	**Dr. Doo Byoung Oh**	MIFAFF	01.01.2010-12.31.2010
Isolation of cancer-preventing substances for bones from peach skin extract	**Dr. Sei Ryang Oh**	MIFAFF	01.01.2010-12.31.2010
Efficacy test of the medical protein (EPO) produced from transgenic pig	**Dr. Sang Rae Lee**	MIFAFF	01.01.2010-12.31.2010
Development of patient-specific organs by using multiple zinc finger nuclease	**Dr. Jeong Woong Lee**	MIFAFF	11.08.2010-11.07.2011
Development of transgenic minipig cell line overexpressed hCD39 for hyperacute vascular rejection	**Dr. Jeong Woong Lee**	MIFAFF	06.01.2010-12.31.2010
Hypolipidemic and Anti-atherogenic Efficacy Test of Agricultural Muschroom	**Dr. Chul-Ho Lee**	MIFAFF	01.01.2010-12.31.2010
Development of nutraceuticals improving dyslipidemia and respiratory inflammation using old Platycodi radix	**Dr. Hyun Sun Lee**	MIFAFF	01.01.2010-12.31.2010

Project Title	Manager	Fund	Period
Investigation of natural material on immunity improvement by regulation of molecular reaction	**Dr. Jae Heung Jeon**	MIFAFF	01.01.2010-12.31.2010
Development and distribution to growers of soybean cultivars containing resistance genes to SMV and bacterial pustule diseases	**Dr. Soon Chun Jeong**	MIFAFF	01.01.2010-12.31.2010
Development of transgene silencing free plant for stable expression of foreign gene	**Dr. Won-Joong Jeong**	MIFAFF	01.01.2010-12.31.2010
Development of functional materials for prevention and treatment of metabolic syndrome from agricultural resources	**Dr. Tae-Sook Jeong**	MIFAFF	01.01.2010-12.31.2010
Specialized cluster for therapeutic antibody business	**Dr. Eun Gyo Lee**	MKE	04.01.2010-03.31.2011
Immunogenicity and toxicity studies of B cell vaccine using NKT cell ligand in monkeys	**Dr. Kyu-Tae Chang**	MEST	06.01.2010-05.31.2011
3P (Paper, Patent, Product) Analysis for Competitive Analysis and Development Plan of Forest Scinece and Technology	**Dr. Byoung Hwan Hyun**	KFS	12.01.2010-11.30.2011
Human and Environmental Risk assessment of transgenic crops	**Dr. Chang Gi Kim**	MEST	04.01.2010-03.31.2011
Immunological Study of Cervical Cancer Therapeutic Vaccine	**Dr. Haryoung Poo**	MIHWAF	05.25.2010-05.24.2011
Development of Pretreatment Technologies for the Production of Mixed Acids from Seaweed	**Dr. Chul Ho Kim**	MKE	12.01.2010-11.30.2011
A Project on the Establishment of Biosafety Information Infrastructure for a Focal Point of BCH	**Dr. Homin Jang**	MKE	01.01.2010-12.31.2010
Efficacy evaluation of pinitol in animal model of osteoporosis	**Dr. Jong Soon Kang**	MIFAFF	05.01.2010-04.30.2011
In vitro activity of a Remicade biosimilar	**Dr. Sang Seok Koh**	MIFAFF	05.01.2010-04.30.2011
Studies on the biological activity of materials for periodontal tissue regeneration using collagen barriers	**Dr. Ki-Sun Kwon**	MIFAFF	05.01.2010-04.30.2011
Development of detection system(kit) for new Influenza A(H1N1) mutant and Tamiflu-resistant virus	**Dr. Dong uk Kim**	MIFAFF	05.01.2010-04.30.2011
Bridging project of formulation material bank	**Dr. Hwan Mook Kim**	MIFAFF	05.01.2010-04.30.2011
Clinical studies and global commercialization of a leading antidiabetic drug	**Dr. Byoung Chul Park**	MIFAFF	05.01.2010-04.30.2011
Study to Evaluate the Antitumor Efficacy of Poly-γ-Glutamic Acid	**Dr. Haryoung Poo**	MIFAFF	09.01.2010-04.30.2011
Development of an anti-inflammatory drug candidate using Curcuma wenyujin	**Dr. Hwan Mook Kim**	CBTP	12.01.2010-11.30.2011
Colorectal cancer therapy based on regulation of function of a novel metastasis inducer TMPRSS4	**Dr. Semi Kim**	MIFAFF	07.01.2010-05.31.2011
Development of Inhibitors of New Anti-mycobacterial Target InhA	**Dr. Won-Gon Kim**	MIFAFF	04.01.2010-03.31.2011
Development of transgenic minipig cell line overexpressed hCD39 for hyperacute vascular rejection	**Dr. Jeong Woong Lee**	MIFAFF	06.01.2010-12.31.2010
Functional study of Intrinsic factors associated with malignant colon cancer	**Dr. Jae Wha Kim**	MIFAFF	04.01.2010-03.31.2011
Establishment of in vivo animal model center for drug discovery support	**Dr. Hwan Mook Kim**	MIFAFF	05.01.2010-03.31.2011
Target validation and therapeutic antibody development using the cancer genomic databases	**Dr. Youngwoo Park**	MIFAFF	04.01.2010-03.31.2011
New Material Research Center for Cosmeceuticals	**Dr. Ick-Dong Yoo**	MIFAFF	04.01.2010-03.31.2011
Center for the development of novel hepatitis B virus antiviral agent and diagnosis of antiviral resistance	**Dr. Young Ik Lee**	MIFAFF	04.01.2010-03.31.2011

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Project Title	Manager	Fund	Period
Studies on cell therapy and development of pluripotent stem cells derived from patients's tissues	**Dr. Yee Sook Cho**	MIFAFF	04.01.2010-03.31.2011
Structural biology studies on a novel anti-cancer action mechanism of imidazoline-based compounds	**Dr. Seung Wook Chi**	MIFAFF	07.01.2010-05.31.2011
Investigation on Structure-Function Relationship of HBX protein	**Dr. Kyon Hoon Han**	MIFAFF	07.01.2010-05.31.2011
The analysis of CXCL-10 antibody in CIA animal model	**Dr. Seon Young Kim**	MIFAFF	10.01.2010-09.30.2011
Development of functional food to improve metabolic syndrome using the medicinal plants	**Dr. Chul Ho Kim**	MIFAFF	10.01.2010-09.30.2011
Develpoment of prodrugs for insoluble drugs	**Dr. Byoung Chul Park**	MIFAFF	10.01.2010-09.30.2011
High resolution impurity profiling for preclinical study	**Dr. Byoung Chul Park**	MIFAFF	10.01.2010-09.30.2011
Development of the next-generation super-biosimilar diabetes therapeutics	**Dr. Doo Byoung Oh**	MIFAFF	10.01.2010-09.30.2011
Development of clinical candidate for general anti-viral pharmaceuticals using NK cell activators	**Dr. Sei Ryang Oh**	MIFAFF	11.01.2010-10.31.2011
Development of beta-glucan mass production and probiotics for livestock	**Dr. Byung Dae Yoon**	MIFAFF	05.01.2010-04.30.2011
In vitro and in vivo efficacy evaluation in support of the development of glycosylation-based prodrugs of poorly soluble drugs	**Dr. Ki Ho Lee**	MIFAFF	10.01.2010-09.30.2011
Development of glycan control and analysis system of glyco-medicine	**Dr. OhSuk Kwon**	MKE	07.01.2010-06.30.2011
Cyber-doctor system to care cardio and cerebrovascular disease using biosensor, personal health device and social network tec	**Dr. Min-Gon Kim**	MKE	04.01.2010-03.31.2011
Development of bispecific antibody platform technology	**Dr. Sang Jick Kim**	MKE	06.01.2010-05.31.2011
Biochemical Crop Protecting Agents for LOHAS	**Dr. Choong-Min Ryu**	MKE	04.01.2010-03.31.2011
Development of anti-cancer antibody specific for HER2	**Dr. YoungWoo Park**	MKE	10.01.2010-09.30.2011
Development of anti-TNF-α/CXCL10 bispecific IgG as a therapeutic agent for rheumatoid arthritis	**Dr. YoungWoo Park**	MKE	04.01.2010-03.31.2011
Development of a LED-based immunosensor module for the rapid screening of respiratory infectious diseases	**Dr. Haryoung Poo**	MKE	04.01.2010-03.31.2011
Engineering human growth hormone for innovative non-parenteral protein drug	**Dr. Seoung Goo Lee**	MKE	10.01.2010-09.30.2011
Production of 2-pyrrolidone through industrial biotechnology	**Dr. Eun Gyo Lee**	MKE	06.01.2010-05.31.2011
Development of materialls for one-spot multiple bioanalysis	**Dr. Bong Hyun Chung**	MKE	07.01.2010-06.30.2011
Commercialization of multi-channel surface plasmon resonance ellipsometer	**Dr. Sang Jeon Chung**	MKE	06.01.2010-05.31.2011
Development of biointerfacing technology for multi-functional nanocomplex	**Dr. Yongwon Jung**	MKE	06.01.2010-05.31.2011
Development of bio-energy production technology using palm-oil byproducts	**Dr. Chul Ho Kim**	MKE	06.01.2010-05.31.2011
Production of recombinant enzymes for the deconstruction of red algae biomass	**Dr. Jung Hoon Sohn**	MKE	08.01.2010-07.31.2011
Nano-patterning Technolohy for the improvement of solar cell efficiency	**Dr. Yong Beom Shin**	MKE	12.01.2010-11.30.2011
Epigenetic investigation of Acute Promyelocytic Leukemia (APL) by Setdb1 study and establishment of new APL leukemogenesis mod	**Dr. Yong-Kook Kang**	MEST	09.01.2010-08.30.2011
Biological evaluation of candidate compounds by genome-wide expression profiling	**Dr. Byoung-Mog Kwon**	MEST	06.30.2010-06.29.2011
Searching for ribonuclease regulators and their characterization	**Dr. Kwang Sun Kim**	MEST	09.01.2010-08.30.2011

Project Title	Manager	Fund	Period
Molecular structure and biological function of cancer-associated proteins and protein complexes	**Dr. Myung Hee Kim**	MEST	10.22.2010-08.21.2011
Development of a pretreatment technology of highly low volume blood, specific antibodies, and antibody immobilization	**Dr. Min-Gon Kim**	MEST	08.16.2010-07.31.2011
Elucidating electron transfer mechanism of Geobacter sulfurreducens	**Dr. Byoung Chan Kim**	MEST	09.01.2010-08.31.2011
Establishment of infrastructures for GEM resources and informatics	**Dr. Hyung Jin Kim**	MEST	06.30.2010-06.29.2011
Construction of Biosafety Management System for R&D LMO	**Dr. Hwan Mook Kim**	MEST	04.01.2010-03.31.2011
Development of peroxiredoxin inhibitor as anticancer agent selectively killing cancer cells	**Dr. Hwan Mook Kim**	MEST	12.15.2010-07.14.2011
Integrated system for oil platform production from organic wastes by microalgae	**Dr. Hee Sik Kim**	MEST	10.22.2010-08.21.2011
Elucidation of interactome and signal network of eprogramming factors	**Dr. Kwang Hee Bae**	MEST	06.30.2010-06.29.2011
Target validation of GAPDH as a therapeutic target of neurodegenerative diseases using nanobio technology	**Dr. Kwang Hee Bae**	MEST	09.01.2010-08.31.2011
Development of next generation bioenergy production systems applicable for various biomass	**Dr. Jung Hoon Sohn**	MEST	10.22.2010-08.21.2011
A novel regulator of angiogenesis and tumor metastasis in hypoxia and its use in the development of targeted therapy of solid	**Dr. Young Il Yeom**	MEST	12.15.2010-10.31.2011
Functional analysis and validation of NUAAP as a novel target in lung cancer therapeutics	**Dr. Mi Sun Won**	MEST	12.15.2010-10.31.2011
Transcriptional regulation of RhoB promoter in the presence of KHG2, a anti-tumor agent	**Dr. Mi Sun Won**	MEST	09.01.2010-08.31.2011
Discovery and Development of Anti-Aging Agents from Natural Sources	**Dr. Ick Dong Yoo**	MEST	09.01.2010-08.31.2011
Integrated Information Infra Construction for Bio-resource	**Dr. Sanghyuk Lee**	MEST	09.01.2010-03.31.2011
Complex natural plant therapeutics for the treatment of hepatitis B	**Dr. Young Ik Lee**	MEST	09.17.2010-09.16.2011
Quantitative analysisof tyrosine phosphorylation in the synapse formation	**Dr. Jae-Ran Lee**	MEST	09.01.2010-08.31.2011
Strategy Development in research related to genetic resource against international regime of ABS	**Dr. Jung Sook Lee**	MEST	05.24.2010-11.23.2010
Discovery and functional studies of lipid metabolism regulators from foreign plants	**Dr. Hyun Sun Lee**	MEST	12.01.2010-09.30.2011
Development of immuno-array chip to detect targetable biomarkers for drug sensitivity prediction and gastric cancer prognosis	**Dr. Sang Jeon Chung**	MEST	06.30.2010-06.29.2011
New Polymers for Selective Surface Control and Its Application	**Dr. Im Sik Chung**	MEST	09.01.2010-08.31.2011
Target validation and application of novel oncogenes for innovative cancer therapy	**Dr. Cho-Rok Jung**	MEST	09.17.2010-09.16.2011
Composition comprising expression or activity inhibitors of TIP41 for the prevention and treatment of cancer	**Dr. Heungchae Jung**	MEST	06.15.2010-06.14.2011
Mutant blocked in glycerol oxidation pathway, and method for preparing 1,3-propanediol using the same	**Dr. Heungchae Jung**	MEST	06.15.2010-06.14.2011
Development of fermentation process for bioisoprene mass production	**Dr. Eui Sung Choi**	MEST	09.01.2010-08.31.2011
Biophysical Studies on Intrinsically Unfolded Proteins	**Dr. Kyon Hoon Han**	MEST	09.01.2010-08.31.2011
Development of DNA chip for assessment of aquatic hazard, using cyanobacterial genome	**Dr. Chi Yong Ahn**	ME	03.01.2010-08.31.2011
Development of practical techniques for measuring aquatic toxicity using biomarkers	**Dr. Hee Mock Oh**	ME	06.01.2010-05.31.2011
Development of analytical technology of low-molecular toxic materials using a surface enhanced Raman scattering combined with bioreceptors	**Dr. Min-Gon Kim**	ME	03.01.2010-02.28.2011
Development of technology for propanediol production from crude-glycerol by strain engineering and scale-up process	**Dr. Chul Ho Kim**	ME	06.01.2010-05.31.2011

LIST OF TECHNOLOGY TRANSFERS

Name of Technology	Date	Director	Company
Personal protective equipment materials to prevent viral infection	Jan 13	**Dr. Dur Han Kwon**	GEMVAX & KAEL CO.,LTD
Portable FRET fluorescent reader with high sensitivity	Jan 20	**Dr. Seung Goo Lee**	FiberPro Co., Ltd.
Technology for detecting methods of molecular interactions	Jan 21	**Dr. Seung Goo Lee**	Reyon Pharmaceutical Co., Ltd.
Technology related to biomaterial for preventing or treating cold	Mar 4	**Dr. Mun-Chual Rho**	SunBiotech Co., Ltd.
Detection kit for protein biomarkers of hepatomas or its particular usage	Mar 8	**Dr. Eun Young Song**	BIOINFRA INC.
Technology on hepatoma protein biomarkers and its diagnostic kit	Mar 8	**Dr. Eun Young Song**	BIOINFRA INC.
Selection technology for phytase clones with improved thermostability and specific activity	Mar 30	**Dr. Jae Gu Pan**	GenoFocus.Inc.
Optimization techonogy on gene manipulation with TOP cloner, using automated equipment	Mar 30	**Dr. Soo Keun Choi**	EnzynoMics
Mass production techonology on potato microtubers (unique technique)	Apr 26	**Dr. Hyouk Joung**	BOKWANG ENERGY CO.,LTD
Technology and unique methods for developing new strains with inhibitory activity against plant pathogens and root rot of ginseng	Apr 27	**Dr. Mun-Chual Rho**	KgBatec Co., Ltd.
Fission yeast strains for marking deleterious recombinant genes	Sep 7	**Dr. Kwang Lae Hoe**	BIONEER CORPORATION
Masks and filters containing Cordata thunb Extracts	Oct 21	**Dr. Dur Han Kwon**	Choongwae Environment Bio Tecnology co.,LTD
Nano contrast medium for Cell Treatment and Bioimaging System	Nov 15	**Dr. Bong Hyun Chung**	U-BioMed Inc.
Ingredients of False Daisy (Eclipta alba) for prevention of Hairloss	Nov 18	**Dr. Seung Ho Kim**	Wavetronics Inc.
Active Ingredients of the extracts or fraction of bean leaves for treatment and prevention of metabolic syndromes such as obesity, hyperlipidemia and diabetes	Nov 18	**Dr. Tae-Sook Jeong**	INSECT Biotech co.,LTD
Analysis system for gene regulation network of micro organism's virulence	Nov 19	**Dr. Cheol Goo Hur**	Insilicogen,Inc.
Production method of active meterials with inhibitory activity to ACAT and its producing strains (including KCTC 11759BP) and strains related to preventing diseases in ginseng (including KCTC 11758BP)	Nov 30	**Dr. Young-Kook Kim**	ELK CORPORATION
Technology related to plant extracts from natural material library	Oct 1	**Dr. Sei Ryang Oh**	Johnson&Johnson
Technology on anti-TNF-alpha antibody	Dec 30	**Dr. Youngwoo Park**	Myung Moon Pharm Co., Ltd.
Technology to utilize microalgae Chlamydomonas with high production of lipids	Dec 30	**Dr. Won Joong Jeong**	CELL&SYSTEM

MAIN EVENTS

1

Jan. 22 Held a signboard hanging ceremony in recognition of excellence in research fund management

2

Mar. 31 Opened the Korean Bio-Information Center

3

Apr. 23 Held the opening ceremony for the World Class Institute (WCI) for Kinomics based Anti cancer Research Center

4

Apr. 27 Concluded a cooperation agreement with the National Institute of Biological Resources

5

Jul. 9 Held an opening ceremony for the Asan Medical Center (AMC) / KRIBB Joint Clinical Research Laboratory

MAIN EVENTS

6

Aug. 25 Signed an MOU with the University of Kinshasa, Democratic Republic of the Congo

7

Sep. 2 Held a KRIBB Science Advisory Committee 2010

8

Oct. 12 Signed an MOU with the National Center for Biotechnology (NCB), Republic of Kazakhstan

9

Oct. 27 Opened the Korea-Hungary Joint Laboratory, Hungarian Academy of Sciences (HAS)

10

Nov. 2 Concluded a Material Transfer Agreement (MTA) with the Standard and Industrial Research Institute (SIRIM), Malaysia

11

Nov. 3 Signed an MOU with the Malaysian Technology Development Corporation (MTDC), Malaysia

12

Nov. 11 Held an opening ceremony for the Brassica Crop Improvement Network

13

Dec. 28~29 Held the 2010 World Class Institute Symposium

RESEARCHER INDEX

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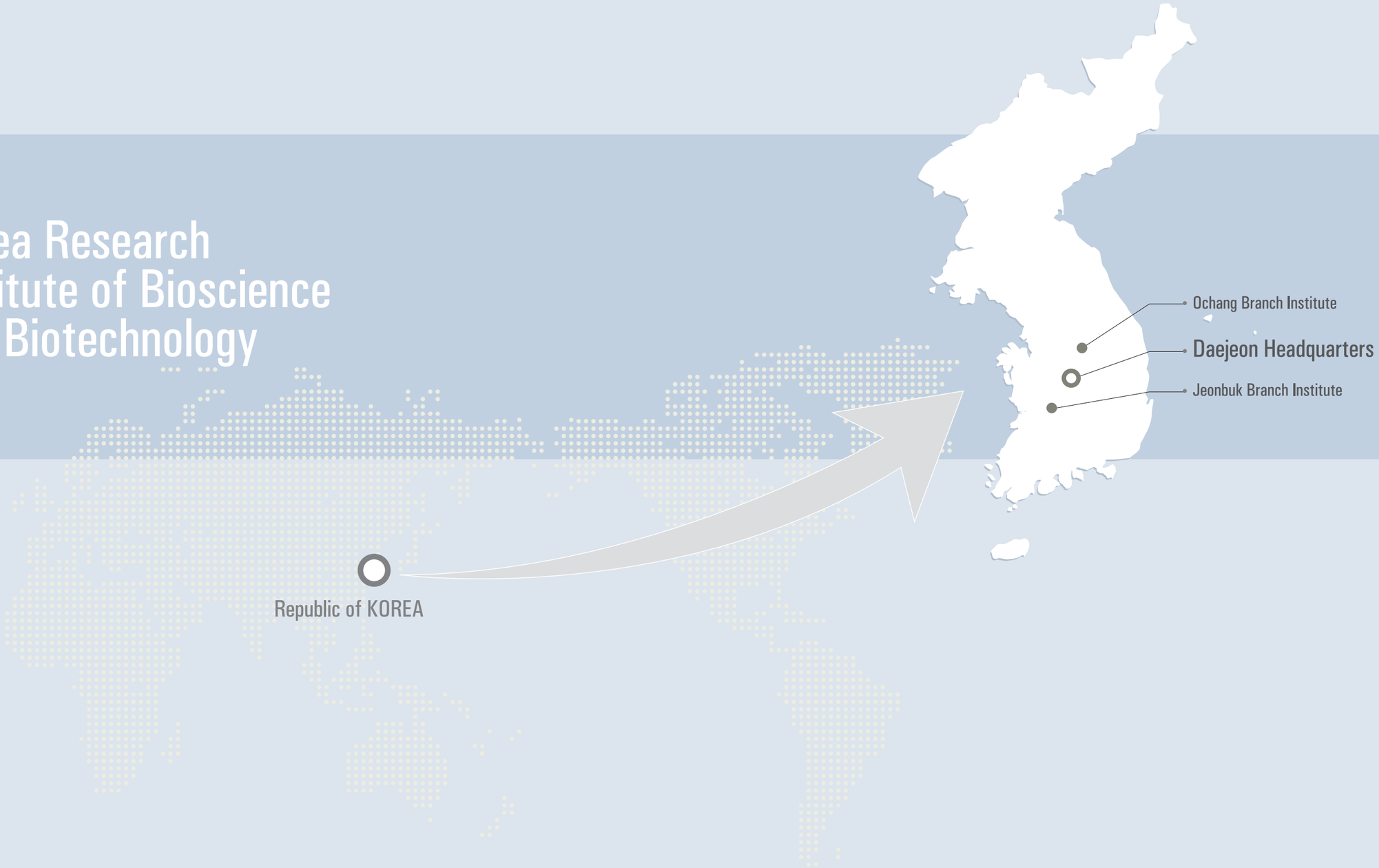
Korea Research Institute of Bioscience and Biotechnology



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