KAST's 20th Anniversary Conference
"Food, Health and the Future"

KAST-KFRI Joint Expert Workshop

Designing Health Food for the Future

미래 건강기능성 식품 설계

Thursday 23 October 2014
Korea Food Research Institute (KFRI)
Seongnam-si, Korea

Organized by KAST 한국과학기술한림원 The Korean Academy of Science and Technology
kfri 한국식품연구원 Korea Food Research Institute

CONTENTS

Opening remark from the Chair, KAST

KAST-KFRI Joint Expert Workshop

Designing Health Food for the Future
(미래 건강기능성 식품 설계)

Opening remark fm the Chair, KAST

Good morning, dear distinguished speakers, discussion participants, and KAST (Korean Academy of Science and Technology) members, thank you for coming and attending this workshop on "Designing Health Food for the Future". And I appreciate very much to KFRI (Korea Food Research Institute), especially, Dr. Dae-Young Kwon helping this KAST-KFRI joint expert workshop held in here.

KAST was founded 20 years ago, 1994. KAST has played a pivotal role in Korean Science and technology by operating a broad spectrum of diverse science programs, advising national level leaders on science policies, etc. The Division of Agricultural and Fishery Sciences has prepared two international conferences in memory of the 20th anniversary. First, today's workshop here, and Second, we are going to have a main 20th Anniversary International Symposium on Food, Health and the Future in Council Chamber, Korea Chamber of Commerce and Industry near Seoul train station tomorrow. I invite you all come to the conference.

Today, we are going to have a round table discussion after two guest speakers' talk. We will have discussion time with the speakers and distinguished speakers for tomorrow, especially, Dr. Robert Huber, Novel prize laureate, and Dr. Marika Mikelsaar.

Finally I appreciate organizing committee members and especially chairman of the Committe, Dr. Cherl-Ho Lee for the designing and programing well of this workshop.

I hope that you can have very fruitful and precious time here getting information on designing health food for the future.

Thank you very much.

Dr. Kun-Young Park
Chair and Fellow
Agricultural and Fishery Sciences Division, KAST

Welcome address

KAST-KFRI Joint Expert Workshop

Designing Health Food for the Future
(미래 건강기능성 식품 설계)

Welcome address

Dear KAST and KFRI Joint Experts Workshop Participants,

It is my great pleasure for me to welcome you on behalf of the Korea Food Research Institute and the Korean Academy of Science and Technology for the Joint Expert Workshop on October 23th, 2014. This round table is free discussions about "Designing Health Food for the Future" with the invited speakers of KAST International Symposium on October 24th, 2014 at Korea Chamber of Commerce and Industry in Seoul, KAST members, Food industry experts and KFRI researchers.

Aging population is accelerated fast in Korea and the healthcare cost is dramatically escalating. With the strong demand on healthy long life, new concept of functional food is bringing the people's attention such as genetics, epigenetics, nutrition, and personalized foods based on the customized food platform technology development. Along with the development of science and technology, healthy functional food market is growing at a remarkable speed. The importance of communication between scientists in the world for finding the value of food will be emphasized by developing science, contents, value, tradition and their culture. Based on finding the value of each traditional food, science technology will be able to develop a new creative area in the world food market. In Korea, traditional fermented foods such as Chungkukjang, Doenjang and Kochujang have been recognized as healthy functional food by their nutritional and pharmaceutical value. By developing the creating shared value on healthy food, we should increase chances to nourish our life.

I believe this workshop brings together the best people from basic science to the food industry and allows you to meet and discuss about designing healthy functional food.

Thank you very much.

Dr. Dae-Young Kwon
Fellow
KAST

PROGRAM

Moderator

- ***Dr. Cherl-Ho Lee*** *(Chair, Organizing Committee / Korea Food Security Research Foundation)*

10:00-10:05 **Opening remark**

- ***Dr. Kun-Young Park*** *(Chair, Agriculture and Fishery Sciences Division, KAST)*

10:05-10:10 **Welcome address**

- ***Dr. Dae-Young Kwon*** *(Fellow, KAST)*

10:10-10:30 **Trends in health functional food market**

- ***Dr. Paul Seehra*** *(Director, Amway Korea R&D)*

10:30-10:50 **Research activities on functional food in KFRI**

- ***Dr. In Wook Choi*** *(Head/Principal Researcher, KFRI)*

10:50-12:00 **Panel discussion**

- ***Dr. Robert Huber*** *(Max Planck Institutes, Germany, 1988 Nobel Prize Laureate in Chemistry)*
- ***Dr. Sang Chul Park*** *(Fellow, KAST / Samsung Advanced Institute of Technology, Korea)*
- ***Dr. Marika Mikelsaar*** *(University of Tartu, Estonia)*
- ***Dr. Sang Woon Choi*** *(Cha Medical University, Korea)*
- ***Dr. Jung Han Yoon Park*** *(Fellow, KAST / Hallym University, Korea)*
- ***Dr. Dong Hwa Shin*** *(Fellow Emeritus, KAST / Chonbuk National University, Korea)*
- ***Dr. Hyun Jin Park*** *(Fellow, KAST / Korea University, Korea)*
- ***Dr. Ki Won Lee*** *(Associate Member, KAST / Seoul National University, Korea)*
- ***Dr. Chang Yong Lee*** *(Fellow Emeritus, KAST / Cornell University, USA)*

12:00-12:20 **Questions and comments by the participants**

12:20-12:30 **Summing up and concluding remark**

- Rapporteur: ***Dr. Youn-Soo Cha*** *(Chonbuk University, Korea),*
Dr. Ok-Kyung Koo *(KFRI)*

12:30 **Lunch**

18:30-20:00 **Welcoming dinner with journalists**

- Place: Woonsan (Kwanghwamoon Yongsusan), Finance Center B1, near City Hall
- Participants: Invited speakers, KAST members and KOFRUM members

KAST-KFRI Joint Expert Workshop

Designing Health Food for the Future
(미래 건강기능성 식품 설계)

Trends in health functional food market

Dr. Paul Seehra, Eun Mi Ko, Dr. Juyeon Park, Dr. Yang Hee Cho

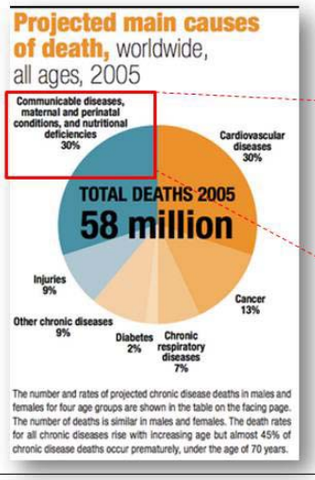
Amway Korea R&D

Chronic disease rates have been rising in many countries, and almost 45% of all deaths from chronic disease are considered premature, i.e. they occur before age 70. Primary ethology of these diseases is unhealthy diet, physical inactivity, and tobacco use. As a result of increasing awareness, many concerned people strive to maintain healthier lifestyles with a more balanced diet to prevent these chronic diseases and improve their physical wellness. The Nutrilite company has an 80 year history of providing pytonutrient-based products under the philosophy "Best of Science, Best of Nature" to supplement unbalanced diets to maintain optimal health. That is, the company philosophy is to increase quality life or human wellness. New product ideation and development begins with assessment of consumer needs, market opportunity, and technology assessment. In this work, we will share market and consumer data from the globe with some South Korea specific information. We will also provide perspective on emerging technology trends. In whole, the global nutrition industry is expected to grow annually 7%. The global supplements market, in 2011, was shown significantly higher growth rate at 7% than the OTC (2%) or RX (4%) markets. In Korea, the health functional food industry has also seen rapid growth for 10 years since HFF regulation took effect; in just the last three years, sales have increased 40% to 1,792 bil KRW (approximately 1.7$b) in 2013 from 1,280 bil KRW in 2010. Clearly there is ample market and consumer need and opportunity globally and in South Korea, but technology trends, scientific maturity, and technical readiness of new ingredients must also be considered before products can be commercialized that can deliver to consumer expectations and meaningfully contribute to sustained growth in the nutrition industry.

Trends in health functional food market

Amway Korea
Dr. Paul Seehra

Global health issues and risk factor



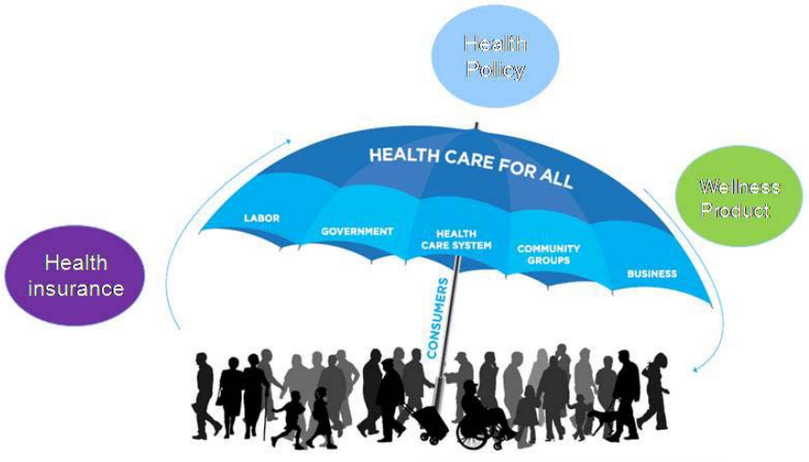
The most common behaviors that lead to chronic disease are ;

- Tobacco
- Insufficient Physical Activity
- Poor Eating Habits
- Excessive Alcohol

The World Health Organization estimates that 80 percent of all heart disease, stroke, and type 2 diabetes, as well as more than 40 percent of cancer, would be prevented if Americans would stop using tobacco, eat healthy, and exercise.
(Ref : WHO, Preventing Chronic Disease : A Vital Investment. 2009)

KIHASA surveyed 10,903 men and women over 30 on seven main health risk actors – drinking, smoking, obesity, lack of exercise, irregular meals, hypertension and high cholesterol. The report says that 43.9 percent of women and 66 percent of men in the study showed two or more risk factors.

How to manage health problems



*Source : Health Care For All's Annual Report

Nutrilite manages health problems

✓ *To prevent chronic diseases and maintain healthier lifestyles, Nutrilite provides wellness products under the philosophy "Best of Science, Best of Nature".*

NUTRILITE® BEST OF NATURE. BEST OF SCIENCE.

Continued investment in technology assets

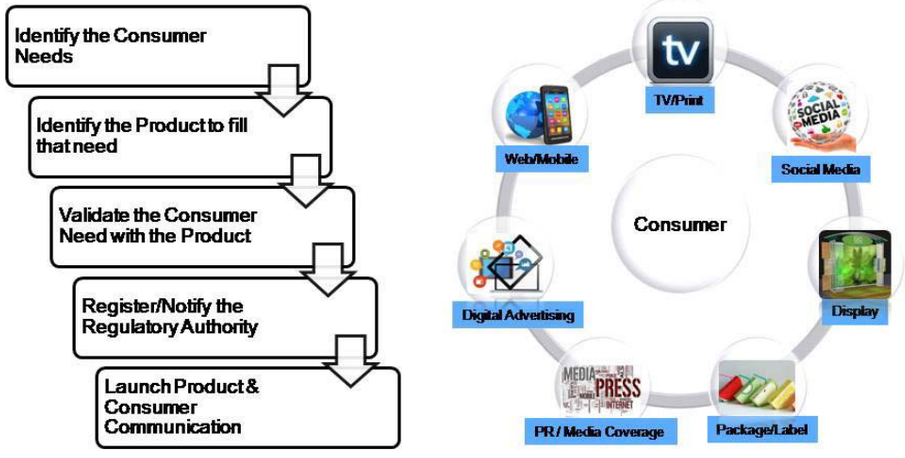
Nutrilite for human wellness

NUTRILITE is the world's #1 selling vitamin and dietary supplements brand* offered exclusively from Amway.

*Source: Euromonitor International Limited. www.euromonitor.com/amway-claims

Consumer needs

From consumer needs To product & communication



Global nutrition industry: Sales + Growth

('13-'16 estimated)

	2013 ($b)	2014 ($b)	2015 ($b)	2016 ($b)	Ave ↑
Functional Food	118.0	125.0	131.8	138.7	5%
Natural/Organic Foods	111.6	118.8	130.0	142.1	10%
Supplements	103.4	108.0	115.6	123.5	7%
Natural Personal Care/Household	41.1	44.8	48.7	52.6	9%
Total Nutrition Sales	374.1	396.6	426.1	456.9	7%

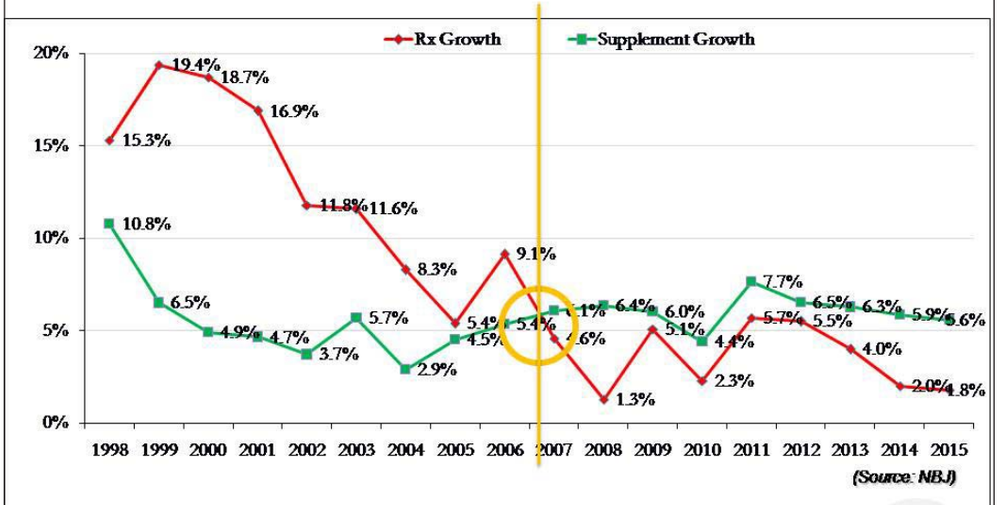
Supplements/OTC/Rx: Sales by Condition

Condition	Suppl	% ↑	OTC	% ↑	Rx	% ↑
Sports/Enrg/Wt.Loss	8,260	11%	380	-24%	890	-30%
General Health	4,560	3%	-	-	-	-
Heart Health	2,130	7%	470	1%	20,830	8%
Cold/Flu-Immune	2,110	6%	5,980	4%	10,310	11%
Bone Health	1,780	1%	-	-	4,170	-1%
Joint Health	1,600	0%	560	6%	13,850	12%
GI Health	1,360	14%	4,780	0%	9,620	-16%
Anti-Cancer	1,270	3%	1,140	6%	8,630	3%
Diabetes	1,100	8%	-	-	18,580	11%
Hair/Skin/Nails	660	15%	2,920	2%	2,760	-1%
Brain/Mental Acuity	580	7%	-	-	2,910	-36%
Sexual Health	520	5%	130	20%	2,130	5%
Mood/Depression	480	6%	-	-	29,630	5%
Menopause	440	5%	120	-2%	2,350	4%
Vision Health	390	6%	590	5%	6,840	5%
Anti-Aging	380	20%	-	-	-	-
Insomnia	330	17%	370	11%	1,660	-17%
Sum of 17 Conditions	**27,950**	**7%**	**17,450**	**2%**	**134,360**	**3%**
Others	2,070	5%	1,590	8%	185,640	4%
Total	**30,030**	**7%**	**19,040**	**2%**	**320,00**	**4%**

(2011; $mm) (NBJ, 2012)

Amway -9-

US supplements vs Rx drugs: Annual Growth

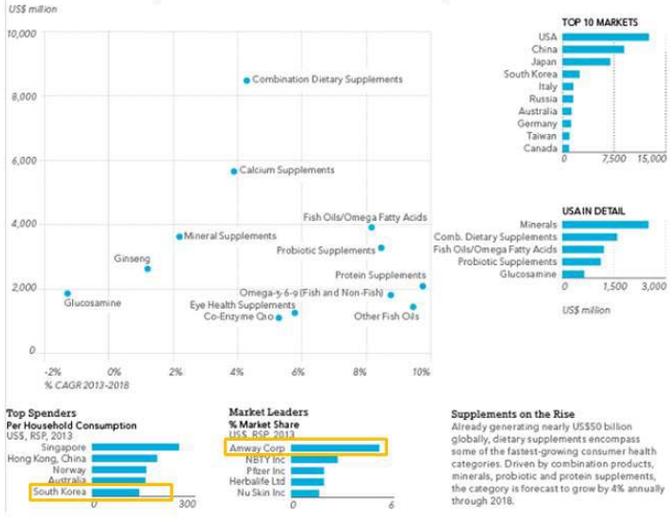


Amway -10-

Global nutrition industry : Sales + Market

Leading dietary supplement categories, global sales

(US $mil, RSP, 2013 and 2013-2018% CAGR)



Source : EUROMONITOR INTERNATIONAL

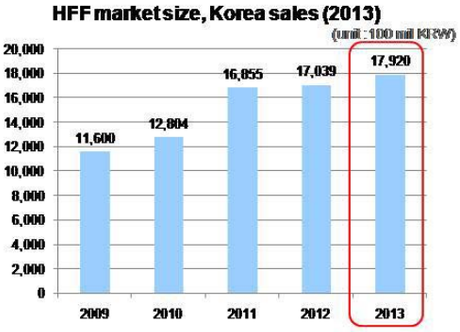
The dietary supplements market is set to grow by 4% annually running up to 2018, with Singapore, Hong Kong and Norway being the top spenders by household consumption, according to Euromonitor International.

Korean HFF industry : Sales + category

- ✓ *Rapid growth for 10 years since HFF regulation effected*
- ✓ *Science based, but limited consumer claim*
- ✓ *Claim discrepancy with conventional or agricultural foods*

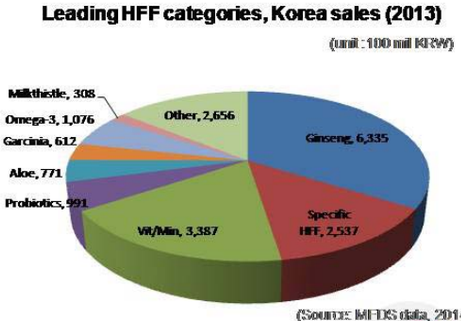
- Market Size 2013 : **1,792 billion Korean won** (approximately $1.7 billion)
- Market Growth Rate 2013 : **production 5.2% ▲, export 32.7%▲, import 12.2%▲** compared to 2012
- Product - Specific HFFs(increased 29% compare to 2012) and Probiotics (increased 55% compared to 2012) lead HFF market growth.

HFF market size, Korea sales (2013)



* Total size = Import + Domestic production – Export (MFDS, 2014)

Leading HFF categories, Korea sales (2013)

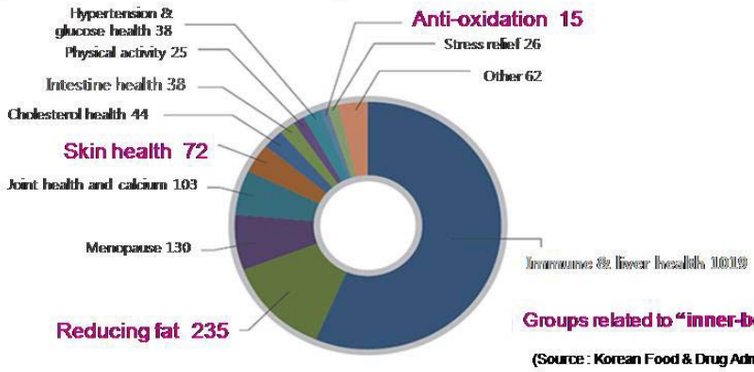


(Source: MFDS data, 2014)

Korean HFF industry : by claim

Market focused on Immune & liver health and Inner beauty (skin/anti-oxidation/reducing fat).

The production volume of HFF by function claim (unit: 100 million Won)



(Source : Korean Food & Drug Administration, 2012)

Global food trend

Digital dining

Edible QR code at Harney Sushi

Smart Knife by Jeon Chang Dae for Electrolux Design Lab.

New food aesthetic

Laser-etched meat by IDEO

Dejunking junk food

Ohso bars. Photograph: Richard Booth/PR company handout

Blueberry chia pod. Photograph: PR company handout

EPIC bar with beef. Photograph: PR company handout

Novel nature

Insects: bar

Plate of soil. Photograph: Thomas Jackson/Getty Images

(Source : Food trends in 2014: from digital dining to healthy junk food) theguardian

Global nutrition trend : Business

Global nutrition trend : Technical

- **More science/better science**
- **Higher-quality (GMPs)**
- **Natural/Organic/Non-GMO**
- **Green (literally and environmentally)**
- **Enhanced bioavailable technologies**
- **Intellectual Property (IP; patents)**
- **Prevention** (vs treatment; 75% of healthcare costs maybe preventable)
- **Personalized nutrition/medicine** (genetic tests; use/measure devices, etc)

Emerging area in HFF
Product trend : Digestion

Healthy digestion

One of every ten Korean has a gastritis disease (Health Insurance Corporation, 2012).
So, future consumer may be interested in stomach health as well as intestine health.

Consumer Needs

[Direct Symptom]

indigestive

irregularity

Feel bloated

Irritable bowel symptom

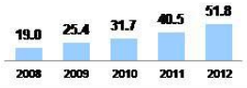
[Baseline]

-Irregular bowel movement
-Weak gut immune function

✓ **Increased probiotics market**

Functional fermented milk market
: 1 Trillion won

HFF – Probiotics Manufacturing



(Unit: bil. won)

✓ **Active research on health benefit of probiotics**

- Intestinal detox
- Enhance immune function
- Effect on improving irritable bowel syndrome, atopic , liver disease, decrease cholesterol, prevent colorectal cancer, etc.

Emerging area in HFF
Product trend : Immune

Immune Health

Increased importance toward immune health

Appearance of super bacteria

- H1N1 hit the world (Y09)
- Appearance of new bacteria can't be cured with existing antibiotics

Increase in immunity disease

- Allergic rhinitis patients 5.3 mil people (Y10)
  : 10% of population (Twice increase in 5 years)
- Stomatitis patients 990K people (Y11)
- Shingles patients 52K people (Y12)
  : 39% increase in 4 years

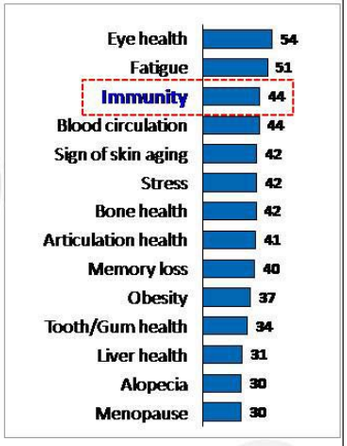
Mass media emphasize the importance of immunity

Increase in related program, documentary , articles etc.

KBS VITAMIN (2012.10)

Perception on Immunity Importance is increased

Needs for HFF Function



Emerging area in HFF
Product trend : **Beauty**

Skin Health

Market size is small, but emerging market

Consumer Needs

Effects of skin care and its convenience.(by 20~30s women)

[Baseline]

-Women interested in skin care and visit esthetic & dermatology

Having **big growth potential**

① Korea has high interest in Beauty
② The interest is expended to the Nutricomelics as well

company	brand	Company sales
CJ CHEILJEDANG	innerb	19 trillion ₩ (2013) (≒ 19 billion $)
AMOREPACIFIC	VB PROGRAM	3 trillion ₩ (2013) (≒ 3 billion $)
yuhan / BEAUTY IN	AQUA Plus	
LG생명과학	re:tune	
HANDOK	NatureSet	

Market dominator

✓ Active ingredient : Collagen, Hyaluronic acid, Vitamin C
✓ Need **some differentiation strategies** using special ingredients or adding special functions.

Ref : Embrain trend monitor (2012)

Amway -19-

Thank you for attention!

"Heat makes objects expand. I blame my gut on Global Warming!"

Amway -20-

KAST-KFRI Joint Expert Workshop

Designing Health Food for the Future
(미래 건강기능성 식품 설계)

Research activities on functional food in KFRI

In Wook Choi, Ph.D.
Head, Food Resource Research Center,
Korea Food Research Institute

As people are more concerned about health, more demands on health food and scientific information on relationship between health and diets are required. In line with these demands, KFRI is making every effort to provide technologies for functional food development as well as information on mechanism by which food components ameliorate metabolic disorders and solve nutritional problems. Here we introduce some of our efforts.

A number of epidemiological studies have implicated that obesity is a primary risk factor for many diseases such as type 2 diabetes (T2D), cardiovascular disease (CVD) and cancer. In human study, obese research subjects who had taken black soybean peptides (BSP) for 12 weeks experienced significant reduction in body weight, body mass index (BMI), and body fat mass. We observed that eleven serum metabolites were increased and 20 metabolites were decreased significantly. In particular, lysoPC 16:0 with a VIP value of 12.02 is esteemed to be the most important metabolite for evaluating the differences between the two groups. Since metabolites present in the blood directly reflect the body°Øs physiological changes, we expect to obtain further insight into the health-promoting effects of soybean peptides as well as that of fermented soybean products that have long been known as healthy food in Korea.

In functional foods coping with allergy, we demonstrated that some ingredients such as Scutellaria baicalensis Georgi (skullcap) inhibited allergen permeation by measuring transepithelial electrical resistance (TEER) and the quantity of permeated OVA in intestinal epithelial Caco-2 cells and in an animal study. These findings demonstrated that skullcap extract might attenuate a food allergic response by inhibiting allergen permeation in vitro and in vivo. We also developed the natural seep aids from Korean foods and plants. We demonstrated sleep-promoting effects of functional food ingredient from brown seaweeds in animal and human study. It is under the review for individual authorized functional foods in KFDA.

KFRI also tries to develop technologies to enhance functional properties of phytochemicals by modifying their metabolism. Although phytochemicals are known to be effective in preventing certain diseases, their poor absorption and poor bioavailability could be big obstacles for their future application. Most phytochemicals are metabolized to more hydrophilic conjugates during absorption and hepatic metabolism. We found that these metabolites play less impact on target tissues than expected. Luteolin has strong anti-inflammatory activities otherwise their hepatic metabolites, including methylated luteolin (diosmetin), showed much lower anti-inflammatory activities. When luteolin and COMT (Catechol-O-Methyl Transferase) inhibitor were co-administered, however, anti-inflammatory activities of luteolin were significantly improved in an animal study. We also searched for phase II inhibitors for the purpose of bypassing conjugation of absorbed phytochemicals in hepatocytes to maintain their bio-functional excellence on target tissues.

Designing Health Food for the Future, 23-Oct, 2014

Research activities on functional food in KFRI

InWook Choi, Ph.D.

Head, Food Resource Research Center,

Korea Food Research Institute

kfri 한국식품연구원 Korea Food Research Institute

Research areas of functional food in KFRI

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Nutrition & Metabolism	◦ Researches on platform technology of personalized foods in aging and disease prevention by systems biology (nutrigenomics, metabolomics) ◦ Researches on nutridynamics (metabolism, absorption, distribution)
Functional Materials	◦ Developes cutting-edge processing technologies for enhancing the physiological activity of food materials ◦ Developes transmitting technology of food nano-bio materials and nano-sensing and imaging ◦ Developes technologies in improving functional properties of ingredients
Functionality Evaluation	◦ Establishes the evaluation methods of bioactive food materials in neuronal disease and allergy ◦ Evaluates the efficacy of the functional food materials and developes the bioactives in cognitive function and sleep disorder
Fermentation & Functionality	◦ Discovers fermented food-derived microorganisms from traditional foods and evaluates its functional effects on human health ◦ Developes gene bank of identified useful microorganisms and discovers the related genes of microorganism from fermented foods

Today's topics are....

1. **Nutrition and health**
   - *Platform technology for personalized functional foods*
2. **Functional Food**
   - *Anti-Allergy*
   - *Sleep Aids*
3. **Improving functional properties**
   - *COMT inhibitors*
   - *UGT inhibitors*

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Research on nutrition and health

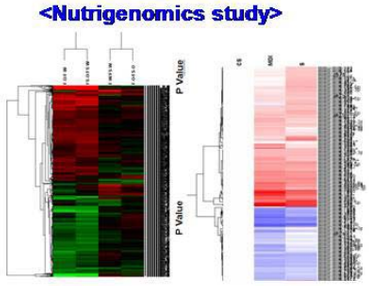
kfri

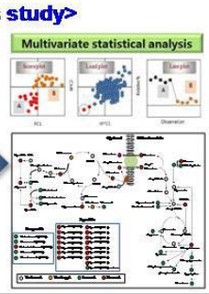
<Research contents>

➢ **Platform technology for personalized functional foods**
- MicroRNA regulation mechanism by bioactive nutraceuticals in obesity
- Metabolite and genomic biomarkers by Omics technology
- Human SNP in Korean population with metabolic disease

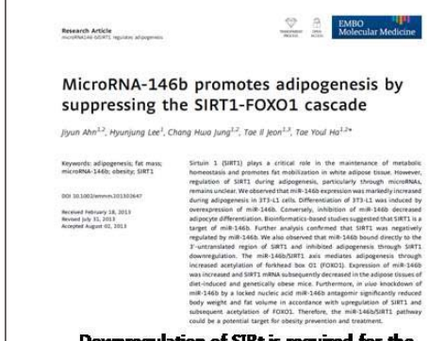
- We discovered 5 functional food factors, which regulates obesity-specific miRNA by nutrigenomics technology
- Using UPLC-Q-TOF MS analysis, we identified significant 52 metabolites in obese mice and human and thus made a perspective pathways
- We identified 13 significant SNPs($p<10^{-5}$) in GWAS of Korean population with metabolic disease: *i.e.*, WWOX, PRKG1, LRPB1

<Nutrigenomics study> **<Metabolomics study>**





MicroRNA regulation mechanism



Research Article

EMBO Molecular Medicine

MicroRNA-146b promotes adipogenesis by suppressing the SIRT1-FOXO1 cascade

Jiyun Ahn[1,2], Hyunjung Lee[1], Chang Hwa Jung[1,2], Tae Il Jeon[1,3], Tae Youl Ha[1,2,*]

Keywords: adipogenesis; fat mass; microRNA-146b; obesity; SIRT1

DOI 10.1002/emmm.201303647

Received February 18, 2013
Revised July 31, 2013
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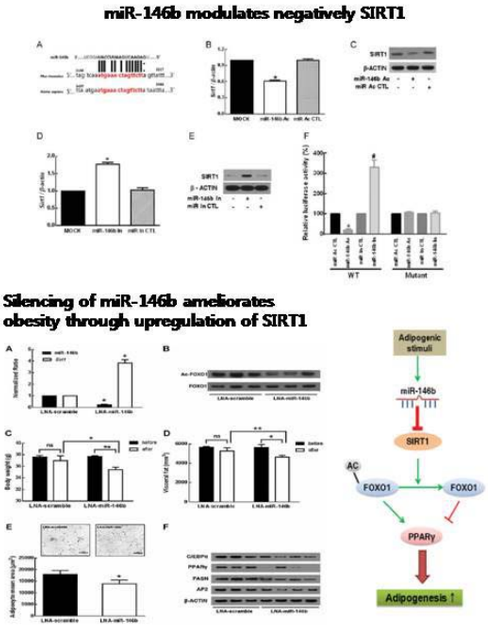
Sirtuin 1 (SIRT1) plays a critical role in the maintenance of metabolic homeostasis and promotes fat mobilization in white adipose tissue. However, regulation of SIRT1 during adipogenesis, particularly through microRNAs, remains unclear. We observed that miR-146b expression was markedly increased during adipogenesis in 3T3-L1 cells. Differentiation of 3T3-L1 was induced by overexpression of miR-146b. Conversely, inhibition of miR-146b decreased adipocyte differentiation. Bioinformatics-based studies suggested that SIRT1 is a target of miR-146b. Further analysis confirmed that SIRT1 was negatively regulated by miR-146b. We also observed that miR-146b bound directly to the 3′-untranslated region of SIRT1 and inhibited adipogenesis through SIRT1 downregulation. The miR-146b/SIRT1 axis mediates adipogenesis through increased acetylation of forkhead box O1 (FOXO1). Expression of miR-146b was increased and SIRT1 mRNA subsequently decreased in the adipose tissues of diet-induced and genetically obese mice. Furthermore, in vivo knockdown of miR-146b by a locked nucleic acid miR-146b antagomir significantly reduced body weight and fat volume in accordance with upregulation of SIRT1 and subsequent acetylation of FOXO1. Therefore, the miR-146b/SIRT1 pathway could be a potential target for obesity prevention and treatment.

Downregulation of SIRt is required for the adipogenic effect of miR-146b

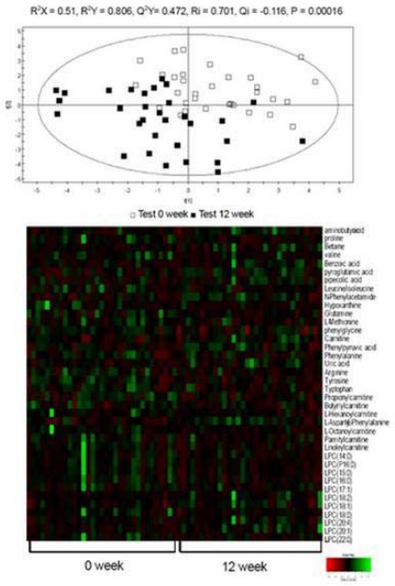


miR-146b modulates negatively SIRT1

Silencing of miR-146b ameliorates obesity through upregulation of SIRT1

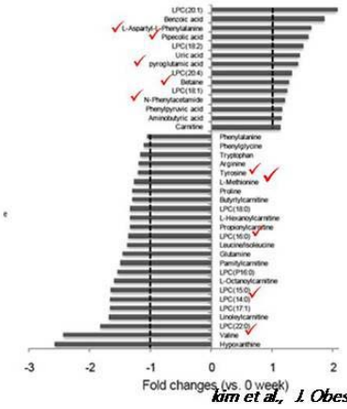
Metabolites changed by nutraceutical (human study)

Metabolite changes of BSP (Black soybean peptides) controlled subjects before and after 12 wks



	0 week	12 week
BMI (kg/m²)	28.0±0.47	27.6±0.48
Body fat (%)	32.0±1.06	31.3±1.07
Energy intake and expenditure		
TEE (kcal)	2514±67.0	2567±63.6
TCI (kcal/d)	2560±59.7	2518±61.5
TG (mg/dL)[b]	134.7±13.7	123.0±12.8
T-chol (mg/dL)	171.7±7.40	173.2±7.24
HDL-chol (mg/dL)	33.7±1.37	39.3±1.77

B.

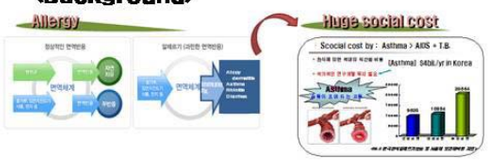


kim et al., J. Obesity, ID: 874981, 2013

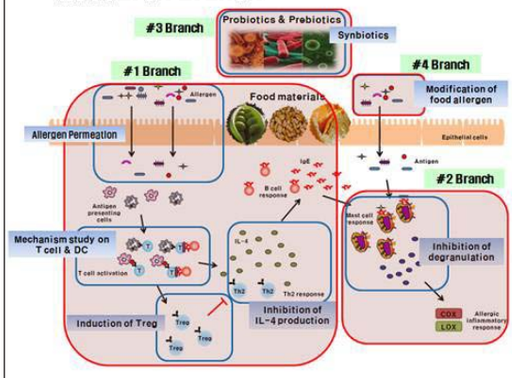
Functional Food (anti-allergic activities)

kfri

‹Background›



‹Research Branch›



‹Final Goal›

- Development of anti-allergic food using natural materials
- Technology transfer for production of health functional food improving hypersensitivity

‹Contents›

- Development of anti-allergic food using natural materials containg T cell controlling activity
  - Control of Th1/Th2 balance
  - Inhibition of allergen passage through intestinal cell layer
  - Induction of regulatory T cell
- Development of anti-allergic food using natural materials containg anti-degranulation activity
- Application and assessment of anti-allergic effect of probiotics
- Development of hypoallergenic food by reducing allergenicity

‹Selection of Materials›

- ❖ 1st Step: (821 items) in vitro/ex vivo screen
- ❖ 2nd Step: (50 items) in vivo screen, by gavage tmt.

Functional Food (anti-allergic activities)

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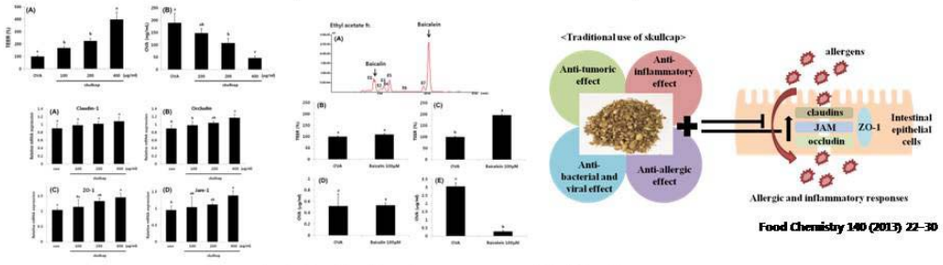
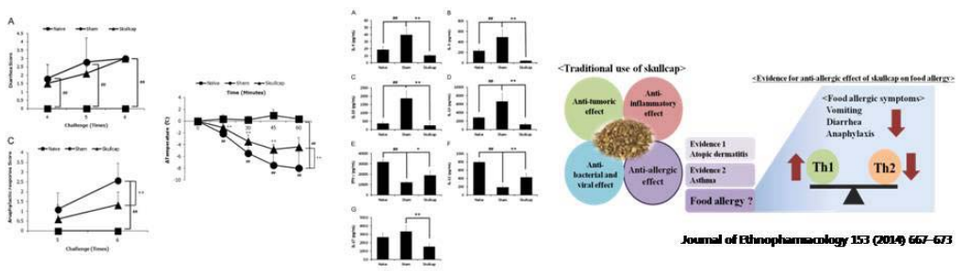
Inhibition of allergen permeation across intestinal epithelium
(Enhancement of intestinal barrier function)



Food Chemistry 140 (2013) 22–30

Anti-allergic effect in a mouse model of food allergy



Journal of Ethnopharmacology 153 (2014) 667–673

Functional Food (sleep aid activities)

[Research Background]

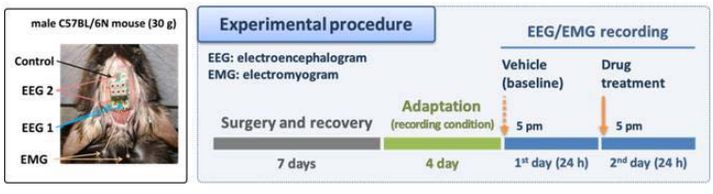
- Sleep accounts for 1/3 of human life and is fundamental for body recovery and energy conservation.
- Insomnia is very common complaint (the global prevalence rate : 30 – 40%).

[Objectives]

- Development of natural sleep aids from Korean foods and plants

[Research Contents]

- Sleep neurotransmitter binding & functional assay
- Sleep architecture analysis based on electroencephalogram (EEG) and electromyogram (EMG)
- Mechanism study using electrophysiological study and knockout mice
- Human clinical trials
- Development of industrial processing and standardization



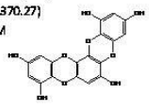
Functional Food (sleep aid activities)

[Major Results]

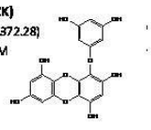
- Phlorotannins: polyphenols from brown seaweeds

Gamtae
(*Ecklonia cava*)

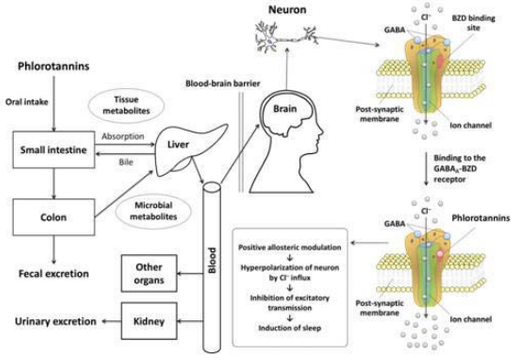
Eckstolonol (ETN)
$C_{18}H_{12}O_8$ (370.27)
K_i 1.49 μM



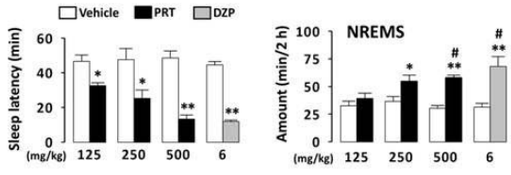
Eckol (ECK)
$C_{18}H_{12}O_8$ (372.28)
K_i 1.07 μM



- Action mechanism: Agonism for benzodiazepine (BZD) binding site of the $GABA_A$ receptor



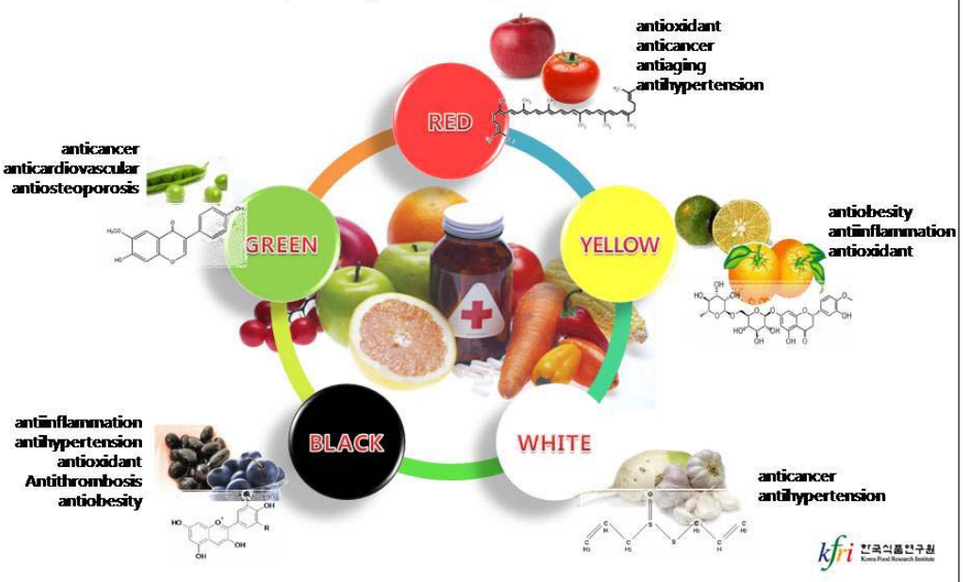
- Sleep-promoting effects of phlorotannins



- Industrial application
  - 5 patents (domestic, Japan, China, etc)
  - In review for individual authorized function foods from KFDA

Improving functional properties of phytochemicals

=Antioxidants of plants=Phyto alexins=Fighter chemicals=Nutraceuticals=The 7th nutrients

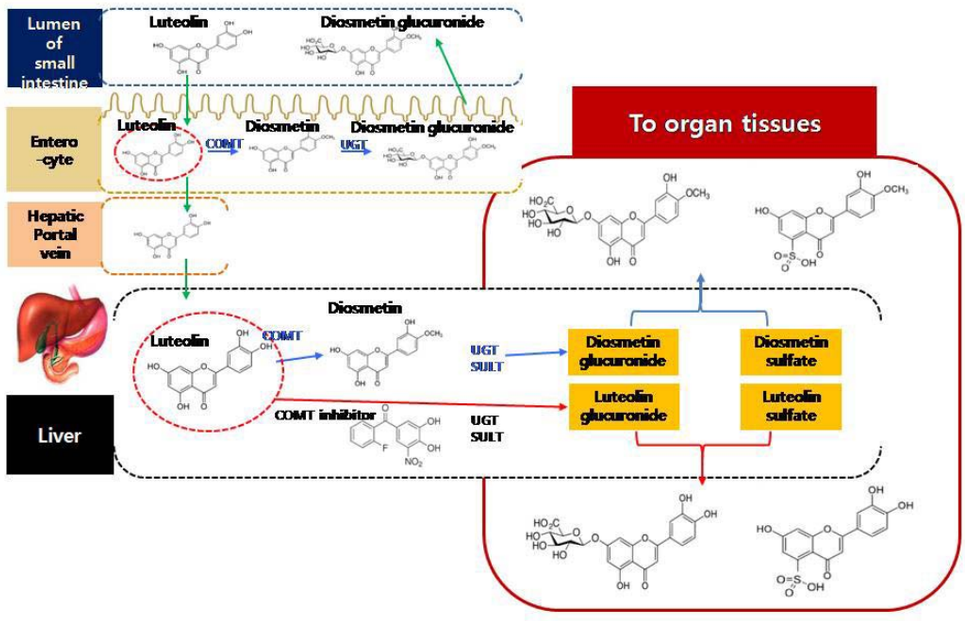


Improving functional properties of phytochemicals

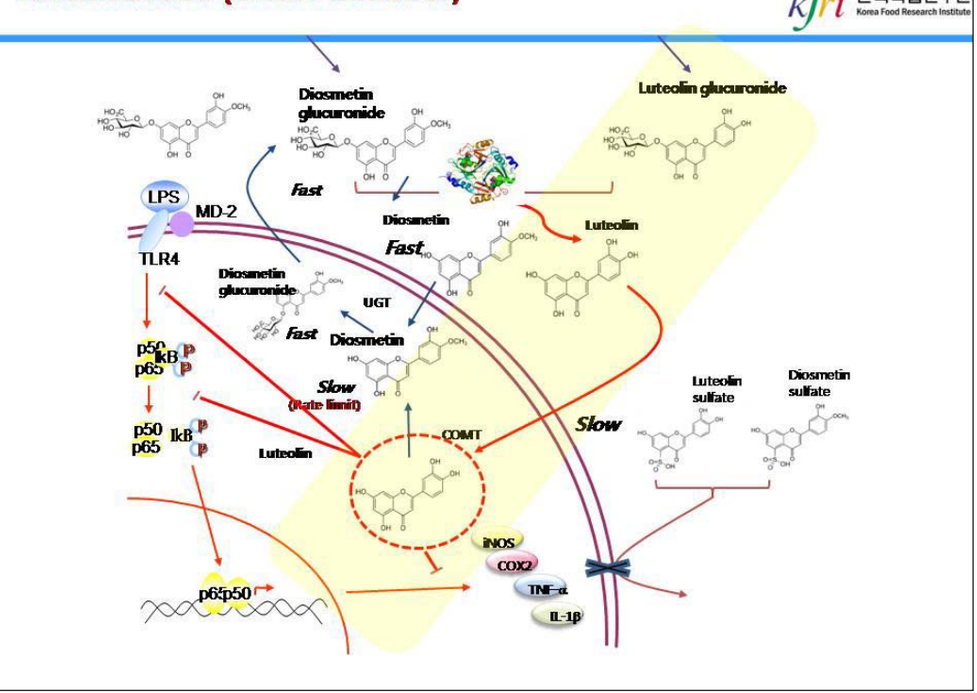
Obstacles to effectiveness of flavonoids

- ***Low bioavailability***
  - Less than 10% of flavonoids orally administered are absorbed into a body.
  - Once absorbed, they are easily metabolized.
- ***Low permeability of hydrophilic metabolites into target tissues***
  - Most of flavonoids are metabolized to glucuronide– or sulphate–conjugates in intestine and liver.
  - Hydrophilic metabolites are not easy to enter into target tissues to perform their functional properties.

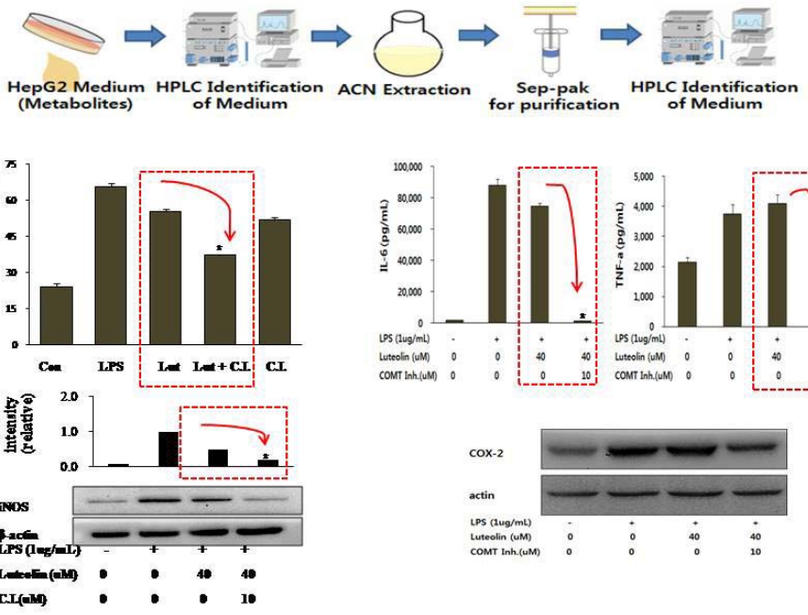
Bioenhancers (COMT inhibitor)



Bioenhancers (COMT inhibitor)



Bioenhancers (COMT inhibitor)



Bioenhancers (COMT inhibitor)

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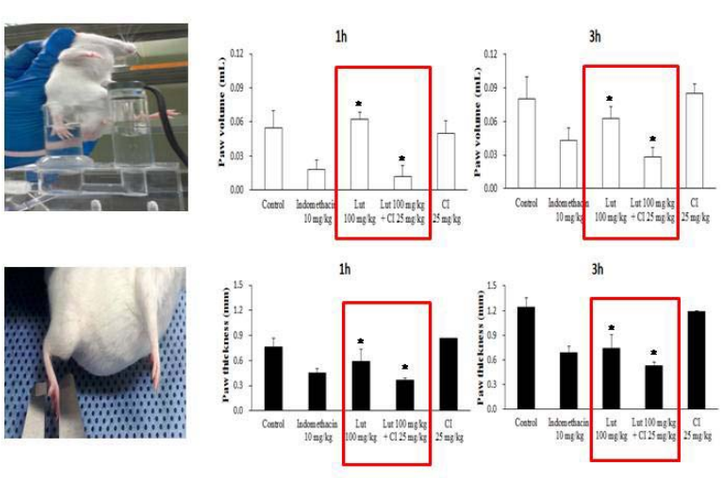
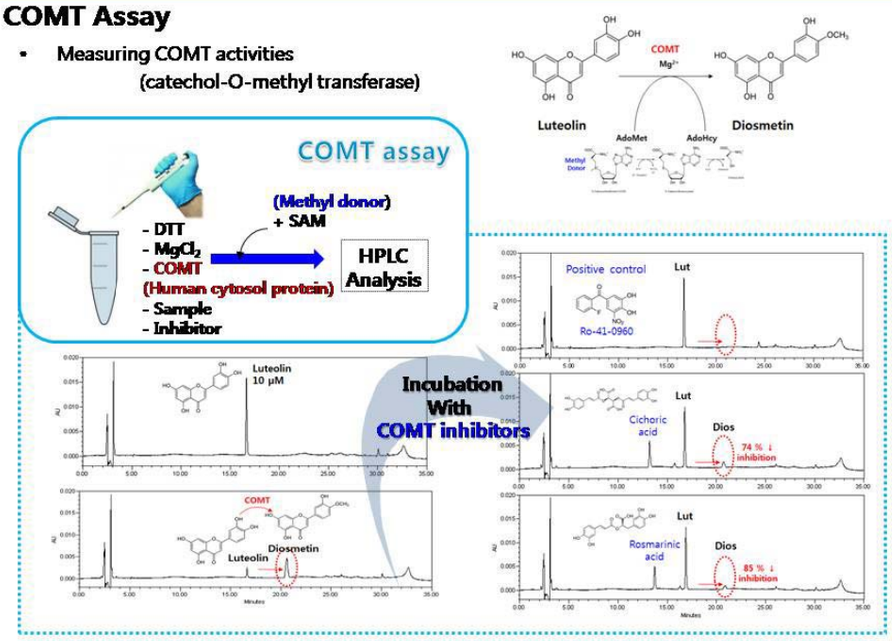
Acute inflammation caused by carrageenan



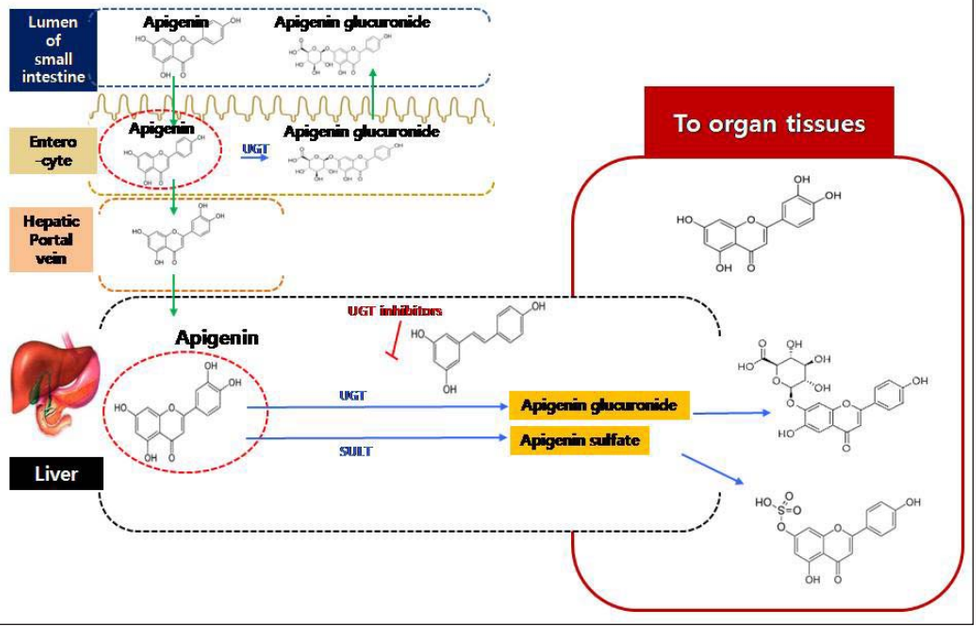
Bioenhancers (COMT inhibitor)

COMT Assay

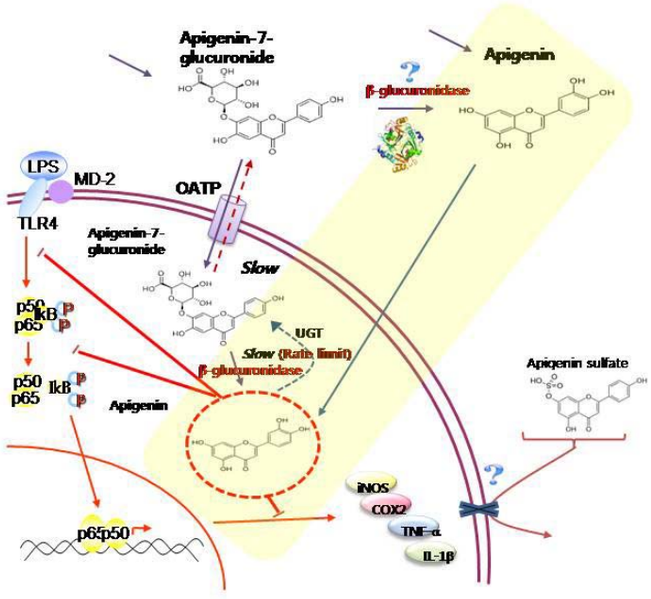
- Measuring COMT activities
  (catechol-O-methyl transferase)



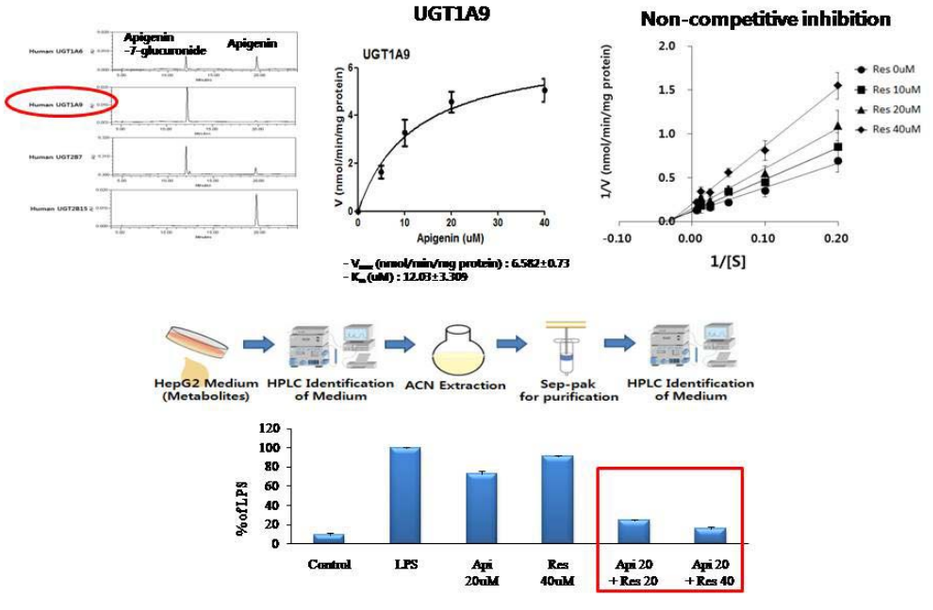
Bioenhancers (UGT inhibitor)



Bioenhancers (UGT inhibitor)



Bioenhancers (UGT inhibitor)




Thank you for your attention.
Food For Your Life
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한국과학기술한림원
The Korean Academy of Science and Technology

List of Participants

KAST-KFRI Joint Expert Workshop

Designing Health Food for the Future
(미래 건강기능성 식품 설계)

KAST Members

Cha, Youn-Soo
Professor
Chonbuk National University
Deokjin-dong 1ga, Deokjin-gu,
Jeonju-si, Jeollabuk-do
561-756
Republic of Korea
Tel: +82-63-270-2013
Mobile: +82-10-8826-3822
E-mail: cha8@jbnu.ac.kr

Choi, YunJaie
Professor
Seoul National University
599 Gwanak-ro, Gwanak-gu, Seoul
151-921
Republic of Korea
Tel: +82-2-880-4807
Mobile: +82-10-4221-6703
E-mail: cyjcow@snu.ac.kr

Huber, Robert
Director Emeritus
Max Planck Institute of Biochemistry
Emeritus Research Group Structure Research
Am Klopferspitz 18
D-82152 Martinsried
Germany
Tel: +49-89-8578-2678
Fax: +49-89-8578-3516
E-mail: huber@biochem.mpg.de

Lee, Chang Yong
Professor
Cornell University
349 Stocking Hall, Ithaca, New York,
14853-7201
USA
Tel: +1-607-255-0114
E-mail: cyl1@cornell.edu

Lee, Cherl-Ho
Chairman
Korea Food Security Research Foundation
401 Bioscience Bld.(East), Korea University,
145 Anam-ro , Sungbuk-gu, Seoul
136-713
Republic of Korea
Tel: +82-2-927-5201
Mobile: +82-10-9347-9213
Email: chlee@korea.ac.kr

Lee, Ki Won
Professor
Seoul National University
599 Gwanak-ro, Gwanak-gu, Seoul
151-921
Republic of Korea
Tel: +82-2-880-4661
Mobile: +82-10-9986-7464
E-mail: kiwon@snu.ac.kr

List of Participants

Dae-Young Kwon
Fellow
Korean Academy of Science and Technology
42 Dolma-ro, Bundang-gu
Seongnam-si, Gyeonggi-do
463-808
Republic of Korea
Tel: +82-10-2284-0747
E-mail: dykwon@kfri.re.kr

Park, Kun-Young
Professor / Chair
Agricultural and Fishery Sciences Division, KAST
Pusan National University
Busandaehak-ro 63beon-gil 2,
Geumjeong-gu, Busan
609-735
Republic of Korea
Tel: +82-51-510-2839
Mobile: +82-10-3872-2839
E-mail: kunypark@pusan.ac.kr

Lim, Yoong Ho
Professor
Konkuk University
120 Neungdong-ro, Gwangjin-gu, Seoul
143-701
Republic of Korea
Tel: +82-2-450-3760
E-mail: yoongho@konkuk.ac.kr

Park, Sang Chul
Vice President
Samsung Advanced Institute of Technology
Samsung 2-ro, Giheung-gu, Yongin-si, Gyeonggi-do
446-712
Republic of Korea
Tel: +82-31-280-9210
Mobile: +82-10-5251-3370
E-mail: scpark@snu.ac.kr

Park, Hyun Jin
Professor
Korea University
145 Anam-ro, Seongbuk-gu, Seou
136-701
Republic of Korea
Tel: +82-2-3290-3450
Mobile: +82-10-3662-6490
E-mail: hjpark@korea.ac.kr

Shin, Dong-Hwa
Professor Emeritus
Chonbuk National University
749-57 Ua-dong 3-ga, Deokjin-gu,
Jeonju-si, , Jeollabuk-do
561-825
Republic of Korea
Tel: +82-63-241-9361
Mobile: +82-10-5280-2570
E-mail: dhshin@jbnu.ac.kr

Yoon, Jung Han Park
Professor
Hallym University
200-702 Hallimdaehak-gil,
Chuncheon-si, Gangwon-do
200-702
Republic of Korea
Tel: +82-33-248-2134
Mobile: +82-10-9159-7130
E-mail: jyoon@hallym.ac.kr

Invited Speakers

Choi, In Wook
Principal Researcher
Korea Food Research Institute
1201-62, Anyangpangyo-ro, Bundang-gu
Seongnam-si, Gyeonggi-do,
463-746
Republic of Korea
Tel: +82-31-780-9097
Fax: +82-31-709-9876
E-mail: choiw@kfri.re.kr

Choi, Sang Woon
Professor
CHA University
120 Haeryong-ro, Pocheon-shi, Gyeongghi-do
487-010
Republic of Korea
Tel: +82-2-3015-5356
Mobile: +82-10-4203-4270
E-mail: sang.choi@cha.ac.kr

Mikelsaar, Marika
Professor / Project Leader
University of Tartu
Ravila 19, Tartu, Tartumaa
50411
Estonia
Tel: +372-737-4170
Fax: +372-737-4172
E-mail: marika.mikelsaar@ut.ee

Seehra, Paul
Director
Amway Korea Ltd.
4F Textile center Bldg,
518, Teheran-ro, Gangnam-gu, Seoul
135-713
Republic of Korea
Tel: +82-2-3468-6094
E-mail: paul.seehra@amway.com

List of Participants

Food Industry Scientists

Choi, Yung Seok
Director
DongA One Central Research Institute
1221-31 Daehomallo, Seokmun-myeon Dangjin-si,
Chungcheongnam-do
343-856
Republic of Korea
Mobile: +82-10-4606-9966
E-mail: knownet@kodoco.com

Jeon, Young Seung
Director
Daesang R&D
697 Jungbu-daero, Majang-myeon
Icheon-si, Gyeonggi-do
467-813
Republic of Korea
Tel: +82-31-639-2020
Mobile: +82-10-8766-6284
E-mail: jeonys@daesang.co.kr

Chung, Guk Hoon
Dosan Biotech Research Institute
864-1 AICT B-dong 5Floor Iui-dong, Yeongtong-gu,
Suwaon-si, Gyeonggi-do
443-270
Republic of Korea
Tel: +82-31-888-9802
E-mail: dstgukho@doosan.com

Kim, Myung Cheol
Director
Korea Food Indusctry Association / Korea Advanced
Food Research Institute
41 Myeongdallo, Seocho-gu, Seoul
137-850
Republic of Korea
Mobile: +82-10-5417-7730
E-mail: kmc6006@naver.com

Ha, Weol Gyu
Director
R&D Center Maeil Dairies Co., Ltd.
480, Gagok-ri, Jinwi-myun,
Pyungtaek-si, Gyeonggi-do
451-861
Republic of Korea
Tel: +82-10-8786-8812
E-mail: woelkyu@maeil.com

Kwon, Sung Oh
President
Nonghyup Food Safety Research Institute
48 Heolleung-ro floor 2
Seocho-gu, Seoul
137-893
Republic of Korea
Mobile: +82-10-7743-6100
E-mail: klfund@naver.com

Moon, Byoung Seok
R&D Management Executive
CJ Cheiljedang Food R&D
518, Gyeongin-ro, Guro-gu, Seoul
152-866
Republic of Korea
Tel: +82-2-2629-5200
Mobile: +82-10-5415-6375
E-mail: moonbs@cj.net

Yoo, Jin Ah
Milk Research Team/Team Leader/Manager
R&D Center Maeil Dairies Co., Ltd.
480, Gagok-ri, Jinwi-myun,
Pyungtaek-si, Kyonggi-do,
Republic of Korea
Tel: +82-31-612-3932
M.B: +82-10-9011-6457
Fax: +82-31-668-0247
E-mail: jinah_yoo@maeil.com

Park, Juyeon
Product Research & Suppport Manager
Amway Korea Ltd.
4F Textile center Bldg,
518, Teheran-ro, Gangnam-gu, Seoul
135-713
Republic of Korea
Tel: +82-2-3468-6253
Mobile: +82-10-9247-9364
E-mail: juyeon@Amway.com

Kim, Jong-Eun
Research Professor / Senior Researcher
Seoul National University
599 Gwanak-ro, Gwanak-gu, Seoul
151-921
Republic of Korea
Mobile: +82-10-3036-3026
E-mail: idonlike@gmail.com

Park, Yong-Ha
CTO/Professor
Probiotic Institute / Yeongnam University
125-11 Daeduk-techno valley techno2ro Yuseong-gu
Deajean
305-500
Republic of Korea
Mobile: +82-10-8968-4620
E-mail: peter@ynu.ac.kr

List of Participants

KFRI members

Ahn, Jiyun
Senior Researcher
Korea Food Research Institute
1201-62, Anyangpangyo-ro, Bundang-gu
Seongnam-si, Gyeonggi-do,
463-746
Republic of Korea
Tel: +82-31-780-9079
Fax: +82-31-709-9876
E-mail: jyan@kfri.re.kr

Ha, Tae Youl
Principal Researcher
Korea Food Research Institute
1201-62, Anyangpangyo-ro, Bundang-gu
Seongnam-si, Gyeonggi-do,
463-746
Republic of Korea
Tel: +82-31-780-9054
Fax: +82-31-709-9876
E-mail: tyhap@kfri.re.kr

Hwang, Jin-Taek
Senior Researcher
Korea Food Research Institute
1201-62, Anyangpangyo-ro, Bundang-gu
Seongnam-si, Gyeonggi-do,
463-746
Republic of Korea
Tel: +82-31-780-9315
Fax: +82-31-709-9876
E-mail: jthwang@kfri.re.kr

Kim, Myung Sunny
Principal Researcher
Korea Food Research Institute
1201-62, Anyangpangyo-ro, Bundang-gu
Seongnam-si, Gyeonggi-do,
463-746
Republic of Korea
Tel: +82-31-780-9229
Fax: +82-31-709-9876
E-mail: truka@kfri.re.kr

Koo, Ok Kyung
Senior Researcher
Korea Food Research Institute
1201-62, Anyangpangyo-ro, Bundang-gu
Seongnam-si, Gyeonggi-do,
463-746
Republic of Korea
Tel: +82-31-780-9370
Fax: +82-31-709-9876
E-mail: okoo@kfri.re.kr

Park, Jae Ho
Senior Researcher
Korea Food Research Institute
1201-62, Anyangpangyo-ro, Bundang-gu
Seongnam-si, Gyeonggi-do,
463-746
Republic of Korea
Tel: +82-31-780-9337
Fax: +82-31-709-9876
E-mail: jaehopark@kfri.re.kr

Shon, Dong Hwa
Principal Researcher
Korea Food Research Institute
1201-62, Anyangpangyo-ro, Bundang-gu
Seongnam-si, Gyeonggi-do,
463-746
Republic of Korea
Tel: +82-31-780-9133
Fax: +82-31-709-9876
E-mail: dhs95@kfri.re.kr

MEMO

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