“Brave New World in Nutrition and Food Safety”

맞춤영양기술을 이용한 식품산업

권 오 랜

ILSI-Korea, 이화여자대학교
Scientific Partnerships for a Healthier World

International Life Sciences Institute

ILSI is a nonprofit, worldwide organization whose mission is to provide science that improves human health and well-being and safeguards the environment.
Brave New World in Nutrition and Food Safety

To learn about **new food safety and nutrition science** and identify areas where ILSI can have an impact on public health.
2019 Keynote Speakers

**Government**

Karl Friedl, PhD  
Senior Physiology Research Scientist, U.S. Army  
*New Technologies and the Fifth Industrial Revolution: What Does This Mean for Research and Advancement in Nutrition Science and Health Promotion?*  
11 January | 8:00 am  
Karl's Bio

Lex M. Bouter, PhD  
Professor of Methodology and Integrity, Amsterdam University Medical Centers and Free University of Amsterdam  
*New Developments in Research Integrity*  
12 January | 2:00 pm  
Lex's Bio

**Academia**

John Floros, PhD  
President, New Mexico State University  
*Science Breakthroughs to Advance Food and Agricultural Research By 2030*  
12 January | 8:00 am  
John's Bio

**Industry**

Elliot Roth  
CEO & Founder, Spira Inc.  
*Infinite Food with Microbes - How Microbes May Hold the Solution for Feeding the World in a Sustainable, Healthy Way*  
12 January | 8:00 am  
Elliot's Bio
Topic to be presented

- Early Days of Nutrition
- Contemporary Challenges in Nutrition
- New Paradigm of Nutrition Research
Early Days of Nutrition

- Public health challenges
  - Communicable disease, short life-span
  - Overt nutrient deficiency
Scientific Focus

• Discovery of vitamins and essential minerals, hunger and malnutrition
The Social Benefits of Biochemical Research

John Steuart Curry, 1942
Absence of single nutrient in diet produces deficiency disease. Provide single nutrient to the diet. Deficiency disease cured or prevented.
Impact on the Market

• Traditional supermarket foods were steadily reduced.
• The presence of absence of **invisible nutrients** was now generally believed to confer **health benefits**.

Source: Google images
Impact on Nutrition Policy/Food Technology

**Nutrition policy and food technology** focused on increasing selected micronutrient

**TWO ways of** increasing nutrient intake for health benefits

- **Supplementary industry**
- **Food fortification**
- **Nutrition labeling**

Ca, P, Fe, I, specific vitamins … to local staple foods
Contemporary Challenges

Disease of deficiency

Disease of excess

DOUBLE BURDEN

Communicable diseases

Life style related non-communicable disease

Mortality rate

Epidemiologic transition
Increased Scientific Focus on NCDs

- Presence of single nutrient in diet produces chronic disease
- Remove single nutrient to the diet
- Chronic disease cured or prevented

Saturated fats, Trans fats, Cholesterol, Sugars, Sodium

Source: Pubmed/Medline
Impact on Nutrition Policy

Nutrition policy emphasized on the need to **avoid and reduce bad nutrients** in particular.

Dariush Mozaffarian. *Foods for thoughts*, 2018
Impact of NCD on Mortality

New Paradigm of Nutrition Research

“The whole is more than the sum of its parts.”
Foods & Health: “Reality is Complex"

Multi-components × Multi targets = Synergistic interactions

- Refined grains, starches, sugars
- Fruits, vegetables, nuts
- Whole grains, legumes
- Yogurt, cheese, milk
- Fish, shellfish
- Processed meats, red meats
- Vegetable oils, specific fatty acids
- Coffee, tea, alcohol
- Sugary beverages, juice
- Minerals, antioxidants, phytochemicals
- Food-based dietary patterns
- Food processing, preparation methods

Blood pressure
Glucose-insulin homeostasis
Liver fat synthesis
Blood lipids, apolipoproteins
Endothelial function
Systemic inflammation
Brain reward, craving
Gut microbiome
Satiety, hunger, obesity
Adipocyte function
Cardiac function
Thrombosis, coagulation
Vasular adhesion

n-3 FA
Technologies Useful for New Paradigm

• **NOT possible** to screen all possible component combinations for all possible indications.
• Expensive & time consuming
• Limit the full investigation of mechanisms.

*In vitro & In vivo*

High-Throughput screening (HTS)

Ommics technology

Jan van der Greef (2006), Pharmacogenomics
What Do We Expect?

• Detailed knowledge capture

• Prediction of responders/non-responders
Detailed Knowledge Capture
Human-on-a-chip

Human-on-a-chip test metabolic responses with personalized cell lines


Karl E. Friedl, 2019 ILSI Annual Meeting
Artificial Intelligence (AI)

- Experiences are powered BY DATA.
[Example] Comprehensive Clinical Trials

Healthy adults (30~65 y, n=56)

- Placebo
- PS 500 mg
- PS 600 mg
- PS 900 mg

Visit 1: Screening
Visit 2: Randomization
Visit 3: 1(wk)
Visit 4: 2(wk)
Visit 5: 3(wk)

OLTT
0, 3, and 6 h

Food diaries 3-day recall
E-diary

Intervention food records
E-diary

Clinical biochemistry

Targeted gene analysis

Food metabolomids
HPLC/MS

Biosample metabolomics (plasma/urine)

High-fat/sugar shake load
- Calories 954 kcal
- Fat 56.6%
- Dextrose 35%
- Protein 8.4%

AI Predictive Model (CODA)

Sanghuang
Danshen

Limited samples
- Plasma
- Blood cells
Ten signature phytochemicals were linked to 32 targets and 143 metabolic/signaling pathways, implicating potential synergistic actions.

Ellagic acid, salvianolic acid B, protocatechuic acid, tanshinone IIA, and caffeic acid showed the highest impact on target proteins.

Mainly through the regulation of **platelet activation/adhesion molecule production** (PLA2G2A, VCAM-1, ICAM-1), **platelet activation/endothelial inflammation** (VEGFA, APAF1, ATF3), **adhesion molecule production/endothelial inflammation** (TP53), and **endothelial inflammation** (23 targets including AKT1, BCL2, CASP3, CD14, CYP1B1, CYP2E1, RELA).
Synergistic Effects of Sanghuang–Danshen Bioactives on Arterial Stiffness in a Randomized Clinical Trial of Healthy Smokers: An Integrative Approach to in silico Network Analysis

Yeni Lim 1,*, Tae-Jin Song 2,*, Woochang Hwang 3, Ji Yeon Kim 4, Doheon Lee 3, Yong-Jae Kim 5,* and Oran Kwon 1,*

Synergistic mechanisms of Sanghuang–Danshen phytochemicals on postprandial vascular dysfunction in healthy subjects: A network biology approach based on a clinical trial

Yeni Lim 1,*, Woochang Hwang 2,*, Ji Yeon Kim 3, Choong Hwan Lee 4, Yong-Jae Kim 5, Doheon Lee 2,* & Oran Kwon 1,*
Prediction of Responders/Non-responders
The **human genome project** opened the era of personalized nutrition.
Monitoring Personal Health


Mark Patrick, 2016
Monitoring Behavior

Karl E. Friedl, 2019 ILSI Annual Meeting
Monitoring Food Intake

Smart eyeglasses

- Chewing cycle recognition
- Distinguish food texture (banana, cucumber, carrot)
- 3D printed glasses personalized to user

Oliver Amft
ACTLab
Univ of Passau

Karl E. Friedl, 2019 ILSI Annual Meeting
**Machine-learning algorithm**

to identify prognostic markers by integrating blood parameters, dietary habits, anthropometrics, physical activity, gut microbiota.

Zeevi et al., Cell 2015 163:1079
Dietary Guideline for Specific Individuals

Food intake data
Physical activity data
Behavioral data

Sample analyses

Personalized nutrition predictor

Recommended Dietary Changes/
Personalized Products
Internet of Things (IoT)
Thank You!