International Symposium on Food Irradiation
"Role of Irradiation in Food Safety & Security"
May 16-19, 2011, Seoul, Korea

Food Security and Irradiation

Prof. Cherl-Ho Lee
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Emeritus Professor of Korea University, Seoul

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World Health Organization

Food security (식량안보 의 정의)

- The World Food Summit of 1996 defined food security as existing "when all people at all times have access to sufficient, safe, nutritious food to maintain a healthy and active life".

- 모든 사람들이 건강하고 활동적인 삶을 영위하기 위한 안전하며 영양가 있는 식품을 항상 충분히 얻을 수 있는 상태

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Three pillars in food security

World Health Organization

- **Food availability** (식품의 가용성)
  - production, supply
- **Food access** (식품의 접근성)
  - price, purchasing power
- **Food use** (식품의 이용성)
  - safety, water hygiene, nutrition knowledge

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Factors determining Food Availability

❖ **Positive factors:**

- **Production will be increased by Biotechnology development.**
- **Food loss will be reduced by irradiation technology**

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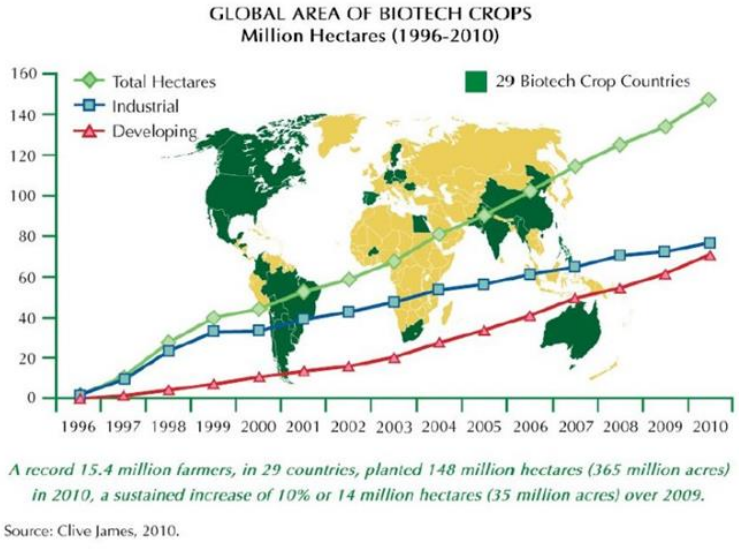

Factors determining Food Availability

❖ **Negative factors:**

- **Production will be decreased by global warming and climate change. (draught, flooding, tsunami)**
- **Supply will be reduced by non-food use of food materials. (Animal fodder, biofuel production)**
- **Massive infectious animal diseases. (AI, Foot & mouth disease)**

Factors influencing Food Access

- World trade liberalization skews even distribution of food.
  The richer gets more and the poorer gets less

- Food prices rise rapidly.
  FAO Monthly Food Price Index recorded to 231 in Feb. 2011.

- Food export restriction of major grain producing countries.
  (Russia, China, etc.)

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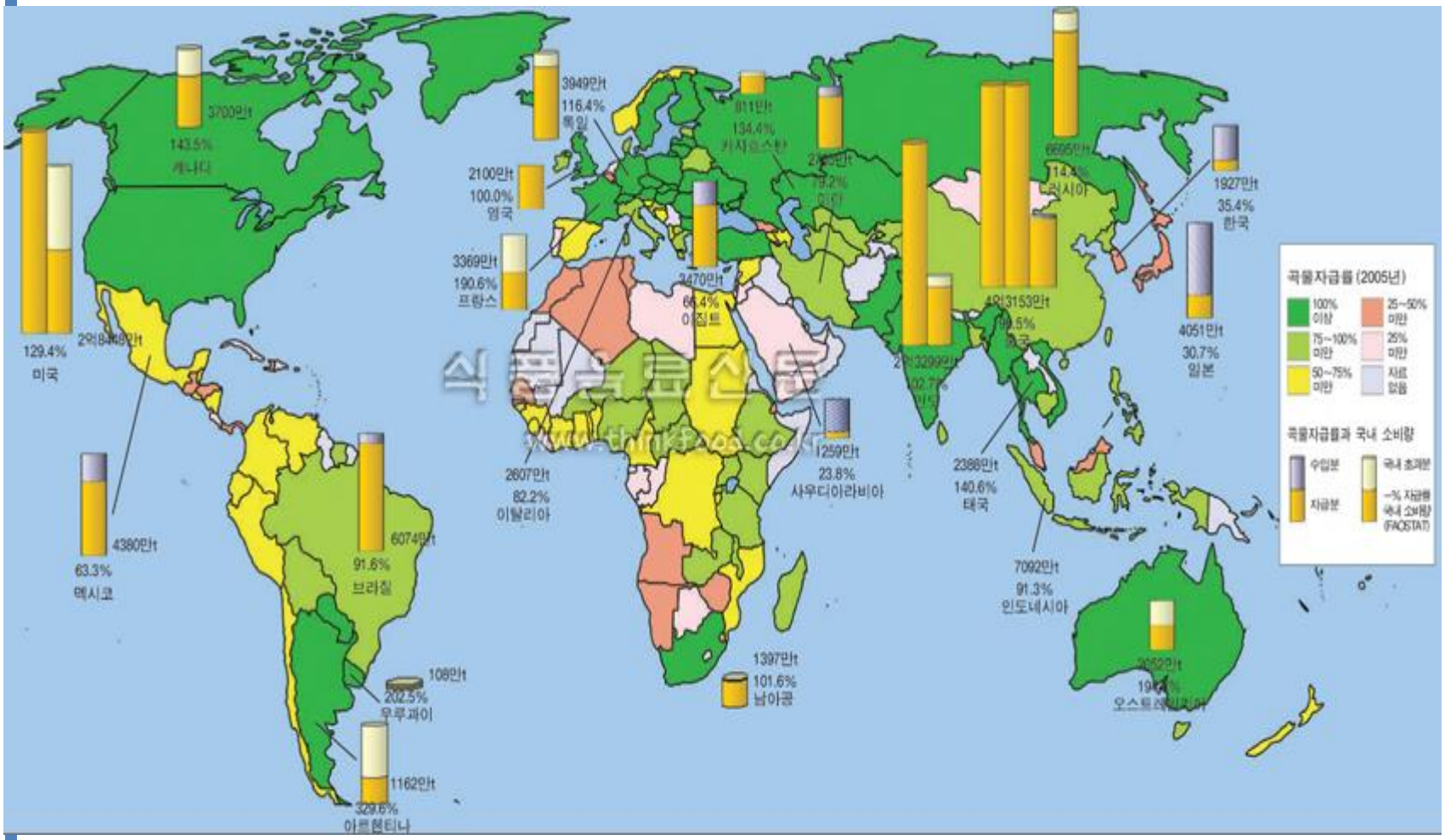
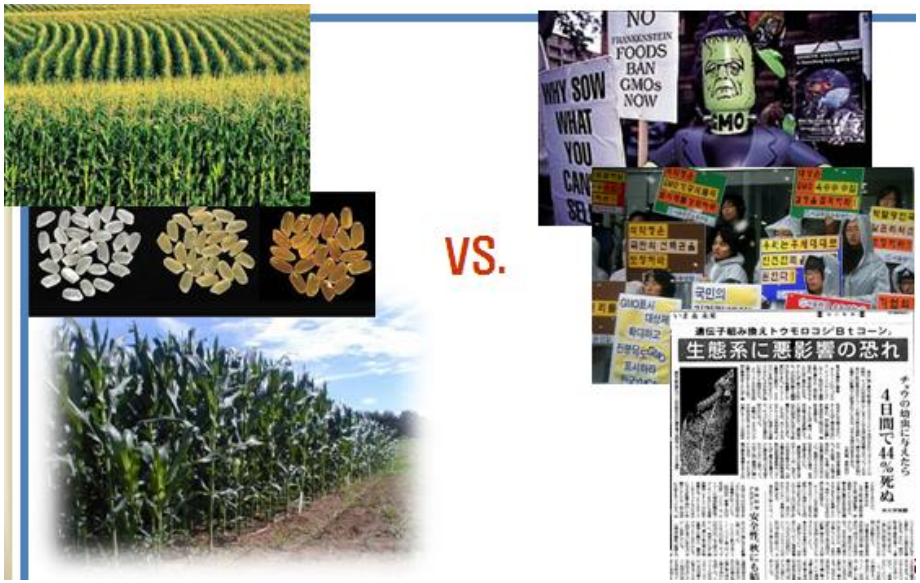
Grain self-sufficiencies



세계 국가별 곡물 자급율

Factors influencing Food Use

- Postharvest loss and food waste
- Poor utilization of food and imbalanced nutrition
- Incidences of food hygiene and adulteration
- Consumer's concern on novel food and new technology



Special situation in Korea

- **Food Security** – very weak
  - 70% of grains are imported.
  - Food energy self-sufficiecy – < 50%

- **Food safety demand** – very high
  - Frequent food safety incidences
  - Mistrust on government action
  - NGO's boycott campaign
  - Silence of scientists

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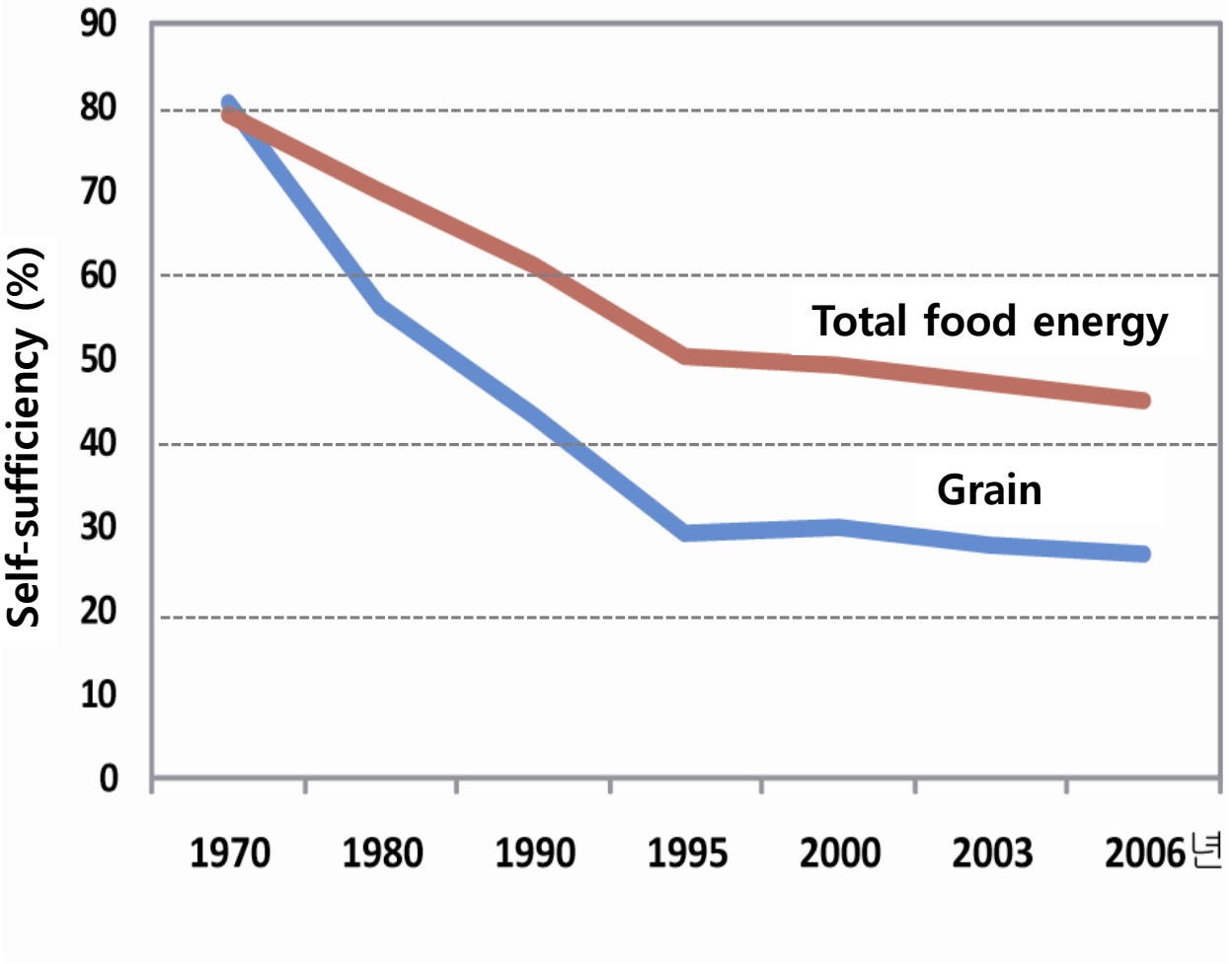
Changes in food self- sufficiency in Korea



Food safety and Food security

- **Two sides of a coin**

- **Mutual colliding and supporting**

  In case of shortage – No room for Safety

  In case of unsafe – No use with pile of food

Food safety ⇧ - Food Availability ⇩, Food price ⇧

A social consensus is needed to harmonize food safety and food security

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2009 IUFoST-Japan
Food Safety and Security Symposium

INTERNATIONAL UNION OF FOOD SCIENCE & TECHNOLOGY

IUFoST

E-Newsline #5

In This Issue

What's New This Week

-Kellogg's to stamp out imitation cereals as Corn Flake sales soar
-Actimel advert banned over 'misleading' claims
-Analyst ups Coca-Cola estimate
-Supermarkets reducing organic ranges
-Kraft to wait for Cadbury's Q3 results
-UK consumers want food labelled with country of origin
-Kraft makes multi-million dollar

IUFoST -JAPAN Food Safety and Security Symposium

September 2009 saw the opportunity for the IUFoST leadership to reaffirm and renew our long relationship with IUFoST founding member, Japan with the IUFoST-Japan Food Safety and Security Symposium, meetings with Japan industry and research institutes, with our colleagues in IUFoST Japan and with hands-on training in Cup-of-Noodle making.

From left: IUFoST Japan President, Tomohiko Mori, Academy Fellow Katsuyoshi Nishinari and Academy Founding Fellow and former IUFoST Governing Council member, Kyoden Yasumoto

The first paper of the symposium was given by Prof Seiichi Homma, the immediate past Commissioner of the Food Safety Commission, in the Cabinet Office of the Japanese government. He reminded us of Japan's high dependency on imported food, some 60% of its needs. Pressure was therefore on government both on food security, and on food safety, as improved methods of analysis lowered detection levels of pesticide residues and contaminants. Then Prof Takanori Mine, Director of Food Safety Research for ILSI Japan

2009 IUFoST-Japan 식품안전 및 식량안보 심포지엄

2009년 9월 12일 일본 나고야대학

- Food Safety and Security in Japan
  Seiichi Homma (passed Commissioner of Food Safety Commission)
- Food Safety and Food Security – IUFoST Global Role
  Geoffrey Campbell-Platt (IUFoST President, Univ. of Reading, UK)
- Food Safety and Security in China
  Piingfan Rao (Fuzhou Univ., China)
- Food Safety and Security in Korea
  Cherl-Ho Lee (Korea Univ,. Korea)
- Food Safety and Security in Canada
  Rickey Yada (Guelph Univ., Canada)

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Korean Dilemma

1. Grain self-sufficiency below 30% - Does Korean government take this situation seriously as crisis and is willing to improve?

2. Rice market will be opened in 2015 – Is Korean rice competitive to the imported rice?

3. Non-GM crops are disappearing from the world market – Are Koreans ready to consume GM food?

4. Ever-increasing constrains on food industries – is Korean food chain sound and responsible for national food supply?

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REVIEW

Food Security: The Challenge of Feeding 9 Billion People

H. Charles J. Godfray,[1]* John R. Beddington,[2] Ian R. Crute,[3] Lawrence Haddad,[4] David Lawrence,[5] James F. Muir,[6] Jules Pretty,[7] Sherman Robinson,[8] Sandy M. Thomas,[9] Camilla Toulmin[10]

Continuing population and consumption growth will mean that the global demand for food will increase for at least another 40 years. Growing competition for land, water, and energy, in addition to the overexploitation of fisheries, will affect our ability to produce food, as will the urgent requirement to reduce the impact of the food system on the environment. The effects of climate change are a further threat. But the world can produce more food and can ensure that it is used more efficiently and equitably. A multifaceted and linked global strategy is needed to ensure sustainable and equitable food security, different components of which are explored here.

12 FEBRUARY 2010 VOL 327 SCIENCE www.sciencemag.org

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Role of irradiation technology for food security

- Prevent food loss
- Improve food quality and shelf-life
- Reduce food poisoning
- Enhance food trade and quarantine control

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Value analysis of IR in Korea

1. Fresh food storage
2. Processed food quality enhancement
3. Processed food shelf-life extension
4. Reduction of food-born diseases
5. Cost for IR detection for food labeling

Food items permitted for irradiation in Korea

Items	Permitted level (kGy)	Main purpose	The date of permition
Potato, onion, garlic	0.15	Prevent germination	1987. 10. 16
Chestnut	0.25	Prevent germination	
Raw and dried mushroom	1	delay maturity	
Dried seasonings	10	Sterilization, Insecticidal effect	1988. 9. 13
Raw material for processed food (dried meat, fish powder)	7	Sterilization, Insecticidal effect	1991. 12. 13
Doenjang, gochujang, gangjang powder	7	Sterilization, Insecticidal effect	
Starch material for seasoning foods	5	Sterilization, Insecticidal effect	
Raw material for processed food (dried vegetable)	7	Sterilization, Insecticidal effect	1995. 5. 19
Dried spice and their processed products	10	Sterilization, Insecticidal effect	
Yeast, enzyme products	7	Sterilization, Insecticidal effect	
Aloe powder	7	Sterilization, Insecticidal effect	
Ginseng(including red ginseng) products	7	Sterilization, Insecticidal effect	
Diets for patients	10	Sterilization	
Raw material for processed food (cereals, beans , their powder)	5	Sterilization, Insecticidal effect	2004. 5. 24
Algae food	7	Sterilization, Insecticidal effect	
Mixed seasonings	10	Sterilization	
Sauces	10	Sterilization, Insecticidal effect	
Powdered teas	10	Sterilization, Insecticidal effect	
Diffusion teas	10	Sterilization, Insecticidal effect	

Korea Food and Drug Administration(2007)

Postharvest losses (%) of some vegetables at various stages of handling

Vegetables	Storage	Grading/ packaging	Transportation	Wholesaler	Retailer	Total loss (%)
Radish	-	6.0	12.0	10.1	5.9	34.0
Korean cabbage	-	6.5	13.0	11.5	7.1	38.1
Pepper	7.0	2.3	2.8	3.5	4.8	20.4
Garlic	9.1	3.1	1.8	6.3	6.4	26.7
Onion	5.4	6.5	3.4	5.4	3.4	24.1
Potato	-	-	-	-	-	25*

Postharvest management technology manual, Garlic. Lee Seong-Koo(2005)

* Semiunderground storage house, Postharvest management technology manual, Potato. Ministry of Agriculture and Forestry (2005)

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Value of post-harvest losses of fresh foods in Korea

				
Average production amount(ton/year)	**627,221[a]**	**382,769[b]**	**165,487[b]**	**968,074[b]**
Losses (%)	**25[c]**	**26.7[d]**	**20.4[d]**	**24.1[d]**
Amount of loss (ton/year)	**156,805**	**102,199**	**33,759**	**233,305**
Wholesale price (Korean Won/kg)[e]	**770**	**4470**	**13666**	**370**
Monetary loss(원)/year (US $ million)	**1,207억 (110)**	**4,568억 (415)**	**4,613억 (419)**	**863억 (78)**

a ; Post harvest management technology manual, Potato. Lim Hak-Tae (2005)
b ; Production amount of seasoning vegetables, Ministry of Agriculture and Forestry (2005)
c : Post harvest management technology manual, Potato. Ministry of Agriculture and Forestry (2005)
d : Postharvest management technology manual, Garlic. Lee Seong-Koo (2005).
e : Korea Agro-Fisheries Trade Corporation (02/05/2011 price, medium-quality)

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Value of processed foods (IR Permitted) wasted by expiring sell-by date (US$)

Items	2008 Year			2009 Year		
	Market price	Returns(%)	Loss value	Market price	Returns(%)	Loss value
Teas	409,272,578	6.30	25,784,173	466,333,598	6.30	29,379,016
Fermented Korean sauce	809,093,352	2.01	16,262,776	835,666,823	2.01	16,796,903
Seasoning	1,550,180,715	1.85	28,678,344	1,859,713,200	1.85	34,404,695
Dressing	138,511,120	0.73	1,011,131	166,663,423	0.73	1,216,643
Total			71,736,424			81,797,256

→ About US$ 82,000,000 wasted by exceeding sell-by date in IR permitted processed foods

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Value of processed foods (IR applied for permission) wasted by expiring sell-by date (US$)

Items	2008 year			2009 year		
	Market price	Returns(%)	Loss value	Market price	Returns(%)	Loss value
Meat, Processed egges	233,627,936	1.85	4,322,117	299,508,574	1.85	5,540,908
Processed fish	384,676,223	4.73	18,195,185	425,855,980	4,73	20,142,988
Dried meat	182,816,315	1.85	3,363,602	214,532,768	1.85	3,968,856
Processed meat	6,579,454,545	1.85	121,719,909	7,881,727,273	1.85	145,811,955
Total			147,600,814			175,464,707

→ About 175,000,000 US$ wasted by exceeding sell-by date in IR permitted processed foods

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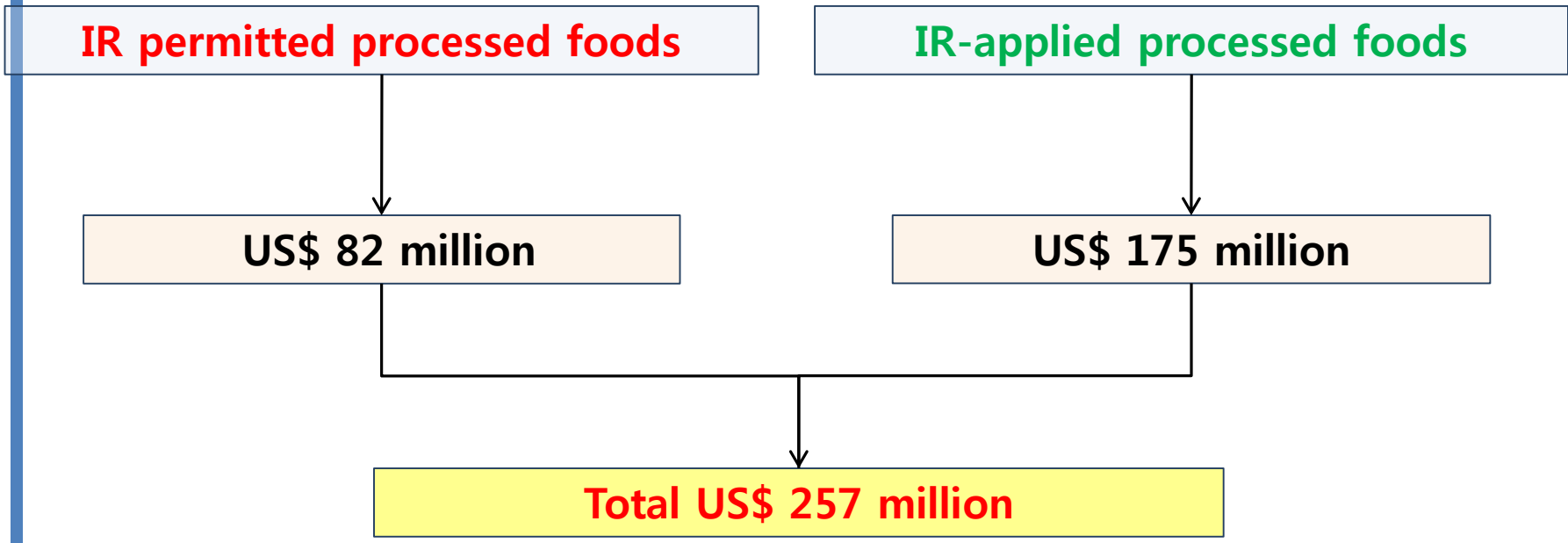
Estimated value of processed foods wasted by expiring sell-by date



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Food Irradiation

Which foodborne diseases could be prevented with irradiation?

Treating raw meat and poultry with irradiation at the slaughter plant could eliminate bacteria commonly found raw meat and raw poultry, such as *E. coli* O157:H7, *Salmonella*, and *Campylobacter*. These organisms currently cause millions of infections and thousands of hospitalizations in the United States every year. Raw meat irradiation could also eliminate Toxoplasma organisms, which can be responsible for severe eye and congenital infections. Irradiating prepared ready-to-eat meats like hot dogs and deli meats, could eliminate the risk of *Listeria* from such foods. Irradiation could also eliminate bacteria like *Shigella* and *Salmonella* from fresh produce. The potential benefit is also great for those dry foods that might be stored for long times and transported over great distances, such as spices and grains. Animal feeds are often contaminated with bacteria like *Salmonella*. Irradiation of animal feeds could prevent the spread of *Salmonella* and other pathogens to livestock through feeds.

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Number of health problems occurred annually in USA

pathogens	cases	major complications	identified source of infection
E. coli O157 and other Shiga toxin-producing *E. coli*	More than 100,000 cases of illness	hemolytic uremic syndrome, chronic renal failure and death	Ground beef
Campylobacter jejuni	2,000,000 cases of illness	GBS(Guillain-Barre' syndrome), an acute neurologic disorder)	Poultry
Salmonella	1,400,000 cases of illness		Meat, poultry, eggs and raw milk
Listeria monocytogenes	2600 cases of severe invasive illness	Infection affects those who have compromised or the undeveloped immune system	Ready to eat processed meats and soft cheese
Toxoplasma gondii	400-4,000 cases of congenital disease/ 200,000 cases of noncongenital illness	hydrocephalus, mental retardation, blindness and death	Consumption of or undercooked meat, especially pork

Food Safety and Irradiation : Protecting the Public from Foodborne Infections, Robert V. Tauxe, CDC(2001)

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Potential Health Benefits of Irradiating Meat and Poultry in USA

1. Assume that 50% of poultry, ground beef, pork, and processed meats are irradiated.
2. Also assume that these foods are the source of 50% of foodborne *E. coli O157, Campylobacter, Salmonella, Listeria* and *Toxoplasma* infection.

Pathogens	cases	Hospitalization	Major complications	Deaths
E. Coli O157:H7 and other STEC	23,000	700	At least 250 cases of hemolytic uremic syndrome	20
Campylobacter	500,000	2,600	250 cases of GBS	25
Salmonella	330,000	4,000	6,000 cases of reactive arthropathy	140
Listeria	625	575	60 miscarriages	125
Toxoplasma	28,000	625	100-1,000 cases of congenital toxoplasmosis	94
Total	881,625	8,500	6,000 catastrophic illnesses	352

Food Safety and Irradiation : Protecting the Public from Foodborne Infections, Robert V. Tauxe, CDC(2001)

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Estimation of food poisoning prevention rate by IR of meat products in USA

	Cases/a year	Cases/ a year By IR foods	Decreasing rate(%)
E.coli O157 and other Shiga toxin-producing *E.coli*	100,000	23,000	23
Campylobacter jejuni	2,000,000	500,000	25
Salmonella spp.	1,400,000	330,000	23.57

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Estimated economic loss caused by food-born diseases in Korea

Coat	Number of patients	Total cost calculated by Bivariate logit (million US$)	Total cost calculated by Bayesian (million US$)
Total number of patients	**11,224,766**	1,116	962
Mild case (no reported)	**9,046,696**	877	734
Serious case	**1,548,612**	158	135
Hospitalization	**629,458**	62	52

Climate change and socio economic cost for food security(2009)

- About 1,116 million US$ economic loss caused by food-born disease in Korea
- 61% of bacterial food poisoning and 30% of food poisoning by Salmonella, Campylobactor jejuni, E.coli are occurred in Korea

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Estimated value of irradiation by preventing food poisoning in Korea

About 1,116 million US$ economic loss caused by food-born diseases in Korea

Loss from bacterial food poisoning (US$ 681 million)

-23.9% decrease by IR food

Cost from prevent of bacterial food poisoning
US$ 163 million

Loss from bacterial food poisoning especially by *Salmonella, Campylobactor , E.coli* (US$ 335 million)

-23.9% decrease by IR food

Cost from prevent of Salmonella, Campylobactor , E.coli food poisoning
US$ 80 million

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Estimated cost of saving by irradiation in Korea

	Million US$
Post-harvest losses of vegetables (IR permitted)	1,022
Value of processed foods wasted by expiring sell-by date (IR permitted processed foods)	82
Value of processed foods wasted by expiring sell-by date (IR-applied processed meats, fishes)	175
Cost from prevention of bacterial food poisoning by irradiation	163
Total possible saving by irradiation in Korea	**1,442**

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Conclusion

- Food security is the most important issue for the future of human society.
- Technological developments including biotechnology and food irradiation can solve the global food crisis.
- In-depth risk and benefit analyses are needed for the new technologies
- Irradiation can reduce the post-harvest loss(US$1,022 million) and processed food waste(US$225 million), and save food poisoning cost(US$163 million) in Korea
- More studies are needed to evaluate the socio-economic benefit of food irradiation
- Education of the people to distinguish irradiated food from radio-active contaminated food is urgently needed.

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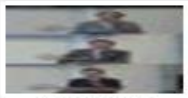
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