Current Activities of Food Irradiation as Sanitary and Phytosanitary Treatment in Asia and the Pacific Region and its comparison with advanced countries

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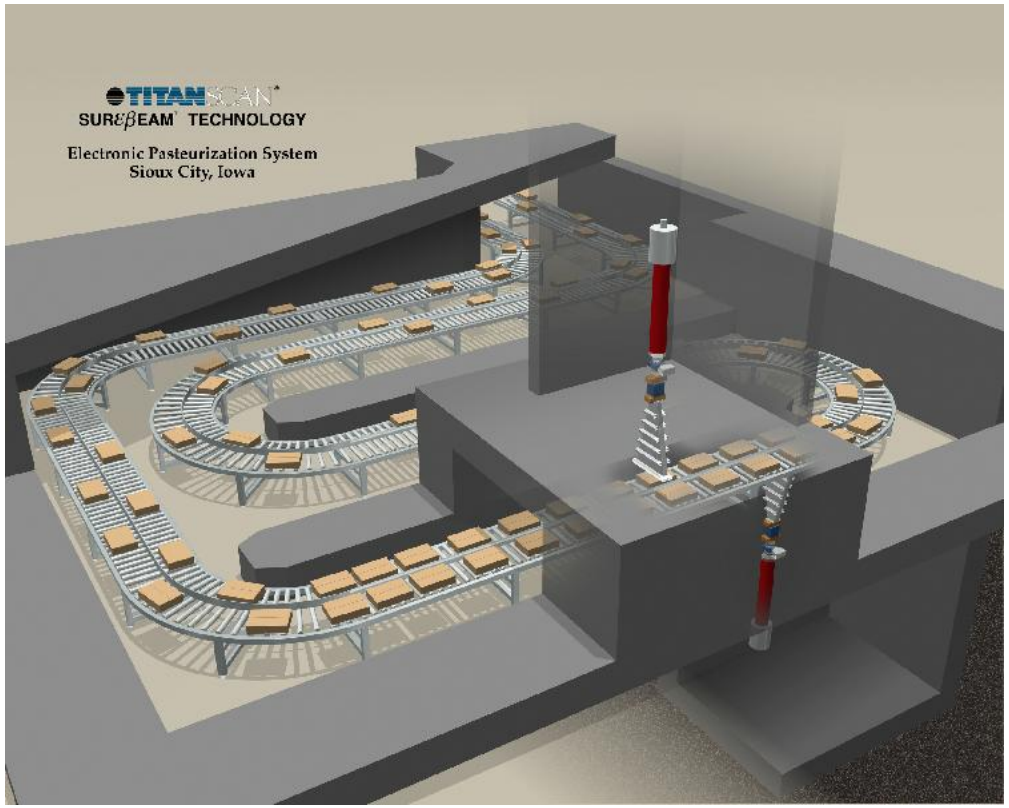
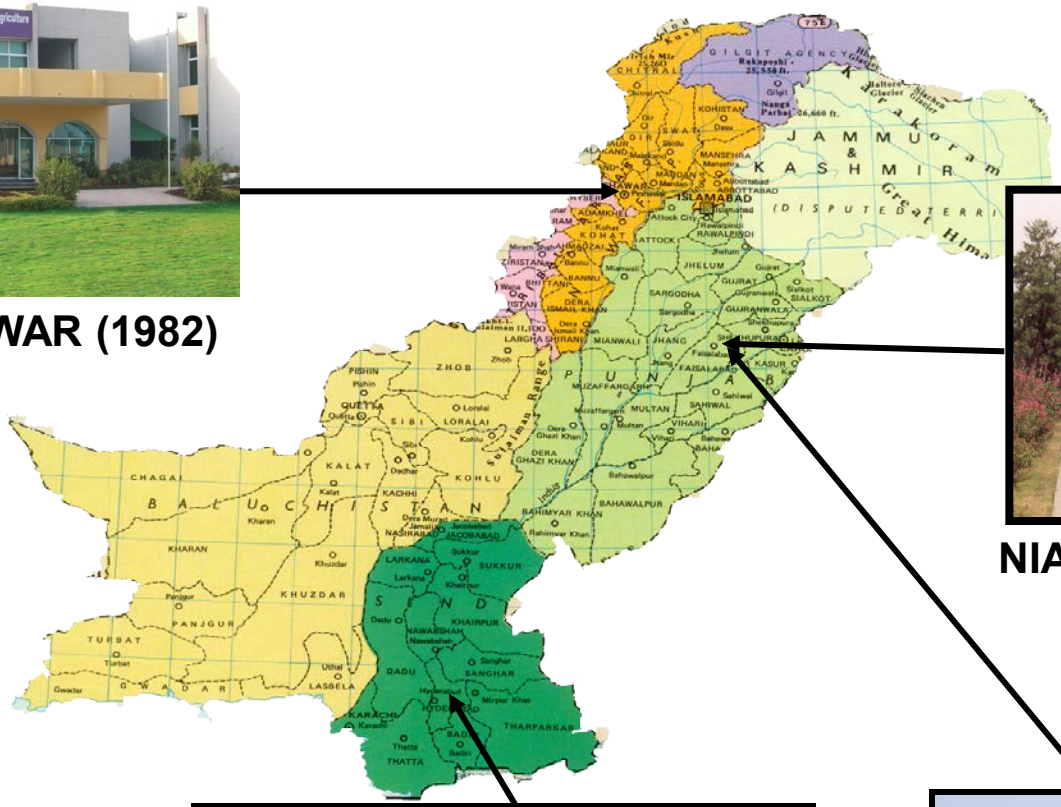


Energy Sources used to Irradiate Food

- Gamma Rays
- Electron Beams
- X-rays

PAEC Agriculture & Biotechnology Institutes

NIFA, PESHAWAR (1982)

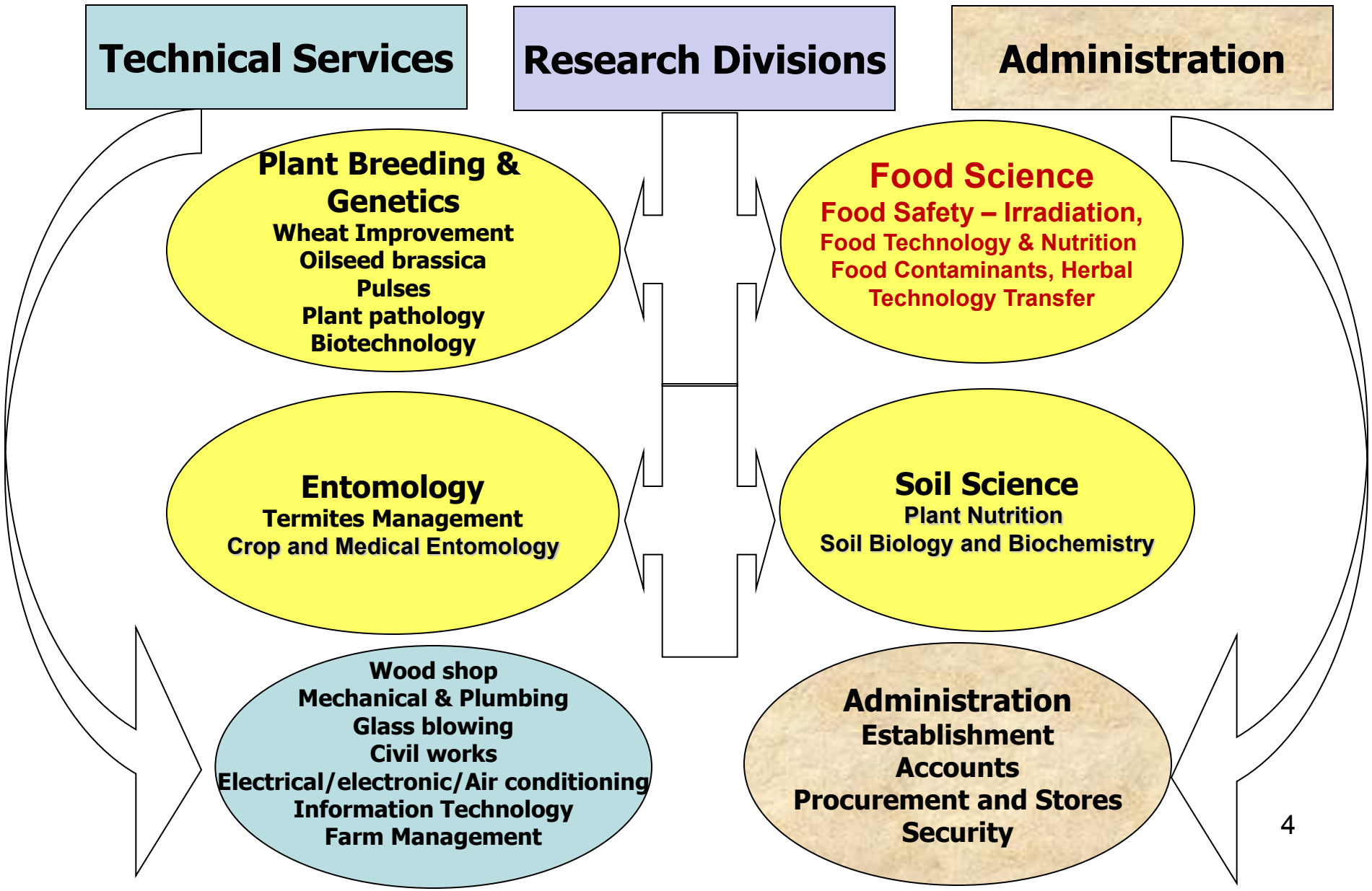


NIAB, FAISALABAD (1972)

NIA, TANDOJAM (1962)

NIBGE, FAISALABAD (1992)

Organization/programs



Introduction

- **Why Food Irradiation by WHO, FAO, IAEA?** Drying, fumigation & Irradiation: Sanitary, phytosanitary & shelf-life on a wide range of products
- **>100 years of research/efficacy studies on Food Safety,** any other food technology, even canning (Smith & Pillai, 2004)
- **Doses, food items**
- **Comparison with EU and US**

Starvation

Food Poisoning

Role of RCA - Asia and the Pacific Region

- RCA-12 June 1972: India, Indonesia, Philippines, Singapore, Thailand and Vietnam
- Regional office: Daejon, Korea in 2002
- Now 18 Member States
- 100 projects completed in different areas

- **Australia**
- **Bangladesh**
- **China**
- **India**
- **Indonesia**
- **Japan**
- **Republic of Korea**
- **Malaysia**
- **Mongolia**
- **Myanmar**
- **New Zealand**
- **Pakistan**
- **Philippines**
- **Singapore**
- **Sri Lanka**
- **Thailand**
- **Vietnam**

Table 1. Regional Projects on Food Irradiation Launched

#	Code	Title	Period
1	RAS/5/020	Food Irradiation Process Control and Acceptance	1989-1996
2	RAS/0/022	Public Acceptance and Trade in Irradiated Food	1995-1998
3	RAS/5/034	Irradiation As Sanitary & Phytosanitary Food Treatment	1999-2001
4	RAS/5/042	Application of Food Irradiation for Food Security, Safety, and Trade	2001-2004
5	RAS/5/046	Novel Applications of Food Irradiation Technology for Improving Socioeconomic Development	2007-2010
6	RAS/5/050	Enhancing Sanitary and Phytosanitary Treatment of Regional Products for Export by Irradiation	2009-2011
7	RAS/5/057	Implementing Best Practices of Food Irradiation for Sanitary and Phytosanitary Purposes	2012-2014

RCA (RAS5057) on "Implementing Best Practices of Food Irradiation for Sanitary and Phytosanitary Purposes"

- 1st Executive Meeting of the NPCs, at Hanoi, Vietnam, March 2012.
- 2nd Executive Management Meeting at Kuala Lumpur, Malaysia, October 2013.
- Senior policy/regulatory officials responsible for food safety and security & NPCs for this project participated in this meeting.
- Aim - to promote awareness of irradiated food and associated technologies amongst food control/regulatory policy authorities in the area
- Information presented by the MSs compiled as:

Regulations

- At present MSs - own national legislations.
- The potential for SPS purpose known since 1920's
- US: Leading country in food irradiation, using commercially for domestic exports from Hawaii, 1st country: generic dose for fruit fly
- 1st international export of irradiated fruit in 2004 when Australia and New Zealand established a protocol for Australian mangoes
- In 2003, Food Standards (FSANZ Standard 1.5.3) is a human health-based food standard that permits irradiation of 12 fruits for phytosanitary and decontamination of herbs and spices.
- Revisions of the Code occurred in 2010 and 2013
- Irradiated food import (1.5.3) to ensure no biosecurity (quarantine pest) threat to New Zealand growers and the economy
- Australia has no class wise approval for fruit and vegetables
- The radiation doses used in Australia are
  - (i) 150 Gy generic treatment for all fruit fly species
  - (ii) 300 Gy for mango seed weevil and
  - (iii) 400 Gy generic treatment for pests

Bangladesh

- Test marketing of irradiated potatoes, onions and dry fishes carried out during 1984-1988
- Bangladesh Standard has specification for irradiated foods which was approved in 1988 (Table 2).
- Bangladesh Standards and Testing Institution (BSTI) published the specifications for the Authorization of Irradiation by Groups or Classes of Food in June 2005.
- The “Revised Codex General Standard for Irradiated Foods, Codex Standard 106, 1983, Rev.1-2003” is adopted by BSTI authorization.
- Bangladesh passed the Plant Quarantine Act in 2011
- Bangladesh developed some commercial protocols for irradiated food for domestic and export purposes.
- Use of irradiation technology for phytosanitary treatment is yet to be started.

Table 2. Clearance for Irradiation of 18 Food Items by Bangladesh Government

Item name	Code	Type of clearance	Dose Max. (kGy)
Chicken	3	Unconditional	7
Condiments	2	Unconditional	1
Condiments	3	Unconditional	10
Fish	3	Unconditional	2.2
Dry fish	2	Unconditional	5
Fish products	3,5	Conditional	7
Froglegs	1,2	Unconditional	1
Mango	1,2,4,5	Unconditional	0.15
Onions	1,6	Unconditional	1
Papaya	1,5	Unconditional	0.15
Potato	1,6	Unconditional	1
Pulses	2	Unconditional	1
Rice	2,4	Conditional	5
Shrimp	3	Unconditional	1
Spices	2	Unconditional	1
Spices	3	Unconditional	10
Wheat	2	Unconditional	1
Wheat products	3	Unconditional	8

China

- China gave clearance to 18 irradiated food hygiene standards in 1994 while irradiation process standards for 17 kinds of foods approved in 2001.
- Specific standards for 3 industries approved/published by the Ministry of Agric. in 2006.

India

•In India, the Atomic Energy (Control of Irradiation of Food) Rules 1996 cover the primary legislation that regulates food irradiation, amended in 2012. Now, food irradiation is:

Governed by	Enforced by
the Atomic Energy Rules, 2012 (Radiation Processing of Food & Allied Products)	Atomic Energy Regulatory Board (AERB)
Food Safety and Standards Act 2006	Food Safety & Standard Authority of India
Plant Quarantine Order, 2004 (Regulation of Import into India)	Department of Plant Protection & Quarantine

•Protocols for quarantine treatment/export of litchi and pomegranate standardized.
•Export of pomegranate from India to USA after irradiation approved by USDA and APHIS.
•Desired dose for quarantine purposes was in the range of 400-1000 Gy.
•Plant parameters were standardized and D_{min} (447 gy) and D_{max} (657 Gy) measured

Indonesia

- Food irradiation has been stipulated in:
  - ✓ Government Regulation-69 in 1999 on Food Labelling & Advertisement
  - ✓ Government Regulation - 28/2004 on Food Safety, Quality & Nutrition
  - ✓ Food Act - 18 in 2012
  - ✓ Regulation of MoH - 701/Menkes/Per/VIII/2009 on Food Irradiation
  - ✓ NADFC Regulation -26 in 2013 on Control of Irradiated Food
- NADFC - authority to control irradiated food, pre market evaluation, registration number & post market control
- BAPETEN - authority to issue utilization permit of irradiation facility
- Indonesia Agricultural Quarantine Agency (IAQA) prepares the standard operational procedure for phytosanitary treatment
- Other alternative treatment accepted are fumigation, hot water treatment, vapour heat treatment, cold treatment and control atmosphere.
- 12 Types of Foods/Products, Purposes of Irradiation and Maximum Absorbed Doses are outlined.

Japan

- Food irradiation is generally banned under “Food Sanitation Law”
- Only permission for gamma-irradiation of potato for sprouting inhibition
- Irradiation as a phytosanitary measure is not used under regulations.
- VHT, cold treatment
- In 2012, MoH initiated research on irradiation treatment of meat product

Republic of Korea

- Food Sanitation Act, nuclear facility and radioactive protection decree were prepared for regulation of food irradiation
- MoH decree - the legal basis for food irradiation business
- Gamma rays from a Co-^{60} source used for 26 food groups
- EB generated from the accelerator below 10 MeV authorized in 2012
- Legislation to allow irradiation on meat products and dried fish products submitted in 2010, but not approved yet.
- Rrecently, MoA decided to support plant quarantine system using irradiation and nominated the KAERI as a leading institute.
- Details of approved irradiation doses are given in Table 4.

Table 4. Domestic Details of Approved Irradiation in Korea

Approved (kGy)	Items	Purpose	Radiation source	Approval Year
≤ 0.15	Potato, Onion, Gallic	Control germination	Co-60	1987
≤ 0.25	Chestnut	Control germination	”	1987
≤ 1.00	Fresh or dried mushroom	Decontamination	”	1987
≤ 5.00	Egg powder, cereals, legumes and their powder as ingredient of food products, starch as ingredient of food products	Decontamination	”	1991
≤ 7.00	Dried meat and the powder of fish & shellfish as ingredient of food product, soybean paste powder, red pepper paste powder, soy sauce powder, dried vegetables as ingredient of food products, yeast & enzyme food, algae food, Aloe powder, Ginseng(including red ginseng) food	Decontamination	”	1995
≤ 10.00	Dried spice & its inferior article, composite seasoning products, sauces, leaching tea, powdered tea, sterile meals for second pasteurization	Decontamination	”	2004
Same as above doses	Same as above items	Same as above purposes	E-beam ≤ 10 MeV	2012

Malaysia

- MoH ensures food safety and protects consumers against fraud in the preparation/sale of food.
- Control of safety in the food supply chain involved MoA, Nuclear Agency and Local Authorities
- Food Act 1983, Food Regulations 1985, Food Irradiation Regulations approved in 2011 (Gazetted for enforcement on 1st October 2013).

Mongolia

- Law on Food Safety was adopted in 2012

Myanmar

- Legislation related to phytosanitary (quarantine) irradiation treatments in process
- Legislative and regulatory framework for radiation safety is through the Atomic Energy Law 1998.
- Department of Atomic Energy performs all the regulatory safety for radiation sources, radioactive materials and irradiation apparatus.

Nepal

- Became member of IAEA in 2008 and in preparation to enter food irradiation era.
- The National Nuclear Policy formulated in 2007 to use irradiation technology for the disinfection and shelf life extension of foods
- Food irradiation as one activity in Country Program Framework 2011-15

New Zealand

- Imports irradiated food subject to compliance with local regulations.
- No existing legislation related to phytosanitary (quarantine) irradiation treatments.

Pakistan

- Food Irradiation Approvals- Gazette Notification Govt. of Pakistan 1996 (Bulbs Root and Tubers; Fresh Fruits and Vegetables; Cereals, Pulses Dried Fruits/Nuts/ Vegetables; Raw Meat, Poultry; Raw Fish/Seafood; Dried Herbs Spices Condiments, Dried Foods of Animal Origins)
- Pakistan Nuclear Regulatory Authority (PNRA) awards license to the irradiation facility on the basis of radiation safety while National Plant Protection Organization licenses the facility on the basis of GMP.
- At the moment Pakistan follows the guidelines as per ISPMs, Codex Alimentarius, WTO (1995) - SPS Agreement, IPPC and Pakistan Plant Quarantine Act 1976.

Philpine

- Philippine Nuclear Research Institute (PNRI) involved together with different collaborating research agencies in the irradiation of food e.g. spices, dehydrated vegetables and herbal products.
- DoA evaluates the feasibility of establishing a commercial irradiation facility in the country.
- Two regulations on the irradiated food i.e. for sanitary treatment approved by the Food and Drugs Administration (DOH AO 152) and for phytosanitary applications approved by the Plant Quarantine Office (BPI AO 02) *in 2008*.
- The Bureau of Plant Industry (BPI), as the NPPO of the country, is responsible for the phytosanitary measure.

Sari Lanka

- National Irradiation Regulations were gazetted in 2005 as part of the Food Act No. 26th of 1980.
- Edited version (2012) is drafted & is awaiting for parliamentary approval.
- DoA appointed a committee to develop the regulations on phytosanitory measures.
- At present, the National Plant Protection Organization (NPPO) is responsible for carrying out plant quarantine activities, using hot air treatment instead of methyl bromide and phosphene

Thailand

- Thailand government classified the irradiated food products into 5 group (225 product types) as:

(a) Herbs and spices; decrease the microorganisms and pathogens
(b) Dried/powder meat, poultry and seafood; decrease the microorganisms and pathogens
(c) Fresh fruits; control insect disinfestation
(d) Meat products; decrease/kill parasite
(e) Dried vegetables; decrease the microorganisms and pathogens.

- The organizations responsible for food irradiation are categorized into 3 parts

(1) Primary process: Departments of Agriculture, Fisheries and Livestock Development
(2) Utilization of radiation: Office of Atomic for Peace
(3) Food irradiation: Food and Drug Administration.

Vietnam

- MoH approved safety and sanitation of 7 kinds of food, 14 October, 2004 (Table 6).
- Certificate of approval for irradiation for quarantine purposes issued to two private companies (An Phu JSC and Son Corp.) by USDA/APHIS/PPQ.

Comparison

- Regulatory aspects of food irradiation in the region are also reported (Roberts, 2000).
- The approved applications for improving safety and reducing food spoilage in the UK. include:
  - ✓ Low dose (less than 1 kGy) irradiation for insect control (for instance in grain and grain products) where a dose of 150-700 Gy is sufficient.
  - ✓ Poultry and poultry products, including mechanically recovered meat, to reduce numbers of *Salmonella, Campylobacter* and other food poisoning bacteria. Doses of up to 3 kGy (fresh) and up to 7 kGy (frozen) have been recommended.
- In 2012 USFDA extended the maximum dosage for poultry to 4.5 kGy.
- Doses of up to 4.5 kGy (fresh) and up to 7 kGy (frozen) recommended for Red meats to reduce *E.coli* O157:H7 and other food poisoning bacteria by the FDA in 2012.
- List of foods and food ingredients authorised for irradiation by EU member states published (EC 2003; OJC 283/5, 24 November 2009).

*Table 5. Notification of Thailand's Ministry of Public Health - Irradiated Food (2010)

Purpose of Irradiation	Maximum Absorbed Dose (kGy)
prevent germination of roots and tubers during storage	Ú
slow down ripeness	Û
control insect disinfestation	Û
decrease the amount of parasite	ı
prolong shelf life	-
decrease the amount of microorganisms and pathogens	ÚÒ

*Regulations on irradiated food for GMP, GAP GID, radiation doses and labelling in 2010.

Table 6. Vietnamese Clearance of Food Irradiation

Class	Food/Purpose of irradiation	Dose (kGy)
1	Agricultural products (bulbs, roots and tubes) To inhibit sprouting during storage	0.1 - 0.2
2	Fresh fruits and vegetables (other than class 1) a) To delay ripening b) Insect disinfestation c) Self-life extension d) Quarantine control	 0.3 - 1.0 0.3 – 1.0 1.0 – 2.5 0.2 – 1.0
3	Cereals, milled cereal products, nuts, oil seed, pulses, dried vegetables and dried fruits a) Insect disinfestation b) Reduction of pathogenic microorganisms c) To delay ripening	 0.3 – 1.0 1.5 – 5.0 0.1 – 0.25
4	Aquatic food and its products including spineless, amphibian animals (fresh or frozen) a) Reduction of pathogenic microorganisms b) Self-life extension c) Control of infection by parasites	 1.0 – 7.0 1.0 – 3.0 0.1 – 2.0
5	Raw poultry and meat and their products (fresh and frozen) a) Reduction of pathogenic microorganisms b) Self-life extension c) Control of infection by parasites	 1.0 – 7.0 1.0 – 3.0 0.5 – 2.0
6	Dry vegetables, spices, and dry herbs a) Reduction of pathogenic microorganisms b) Control of infection by parasites Some spices (pepper, ginger powders, oregano, mint leaves…) can be irradiated with dose up to 12 kGy as in TCVN 7415: 2010	 2.0 - 10.0 0.3 – 1.0
7	Dried food of animal origin a) Control of infection by parasites b) Control moulds and fungus c) Reduction of pathogenic microorganisms	 0.3 – 1.0 1.0 – 3.0 2.0 – 7.0

Labelling/Packaging

- Obligatory: Irradiated foods must be labelled (Codex, 1991).
- Food often pre-packaged before irradiation to prevent re-contamination, it is possible that irradiation might either affect barrier properties or that radiolytic products formed in the packaging might be absorbed into the product.
- Topic covered in “High-dose irradiation: Wholesomeness of food irradiated with doses above 10 kGy” (WHO, 1999).
- USFDA requires that packaging be evaluated and approved before irradiation.
- Evaluation of the suitability of new packaging materials is given by Komolprasert (2007).

Sensory Evaluation

- The irradiation process is not suitable for all products.
- Foods with high fat contents, such as fatty fish and some dairy products, develop off-odours and tastes due to rancidity, even at low doses.
- Loss of firmness can occur with some fruits and vegetables.
- Foods with high protein content, such as meat and poultry, can suffer from changes in flavour and odour after irradiation at ambient temperatures but can be reduced/minimised at chill & frozen temperatures, respectively.
- For fresh ground beef with a high fat content and for fatty pork products, the dose should not exceed 2.5 kGy to prevent rancidity.
- Liquid and dry eggs can tolerate doses in excess of 3 kGy, but for shell eggs a 2 kGy dose can cause deterioration of the yolk sac membrane.
- Milk develops an off-flavour at relatively low doses but various cheese show good tolerance at doses up to 3 kGy (Bhumiratana et al., 2007; Bruhn and Schutz, 1989; Diehl, 1983).

Detection

- Analytical methods that can discriminate between irradiated and non-irradiated foods are required if labelling regulations enforceable.
- A range of analytical methods are based on the detection of physical, chemical and microbiological changes that can occur in irradiated food.
- The widely used methods: ESR, TL, PSL and the detection of long-chain volatile hydrocarbons and 2-alkylcyclobutanones.
- All methods adopted by Codex (Arvanitoyannis, 2010; CEN, 2009; Atta et al., 2003).

High Dose Irradiation

- The current upper limit of 10 kGy is insufficient to achieve sterility (IAEA, 2010).
- The revised Codex General Standard (2003) for irradiated foods now reads, “the maximum absorbed dose delivered to a food shall not exceed 10 kGy, except when necessary to achieve a legitimate technological process”.
- Foods sterilised by high dose irradiation (>25 kGy) consumed by astronauts in the NASA space shuttle programme because of their superior quality and variety, compared to foods treated by other preservation technologies.
- Increasing demand for sterile products for immunocompromised patients as well as for niche markets, such as the military, campers or disaster victims where a long shelf life at ambient temperatures is required.
- High dose sterile foods may be prepared under medical supervision for immunocompromised patients without labelling.

Irradiation Facilities

Country	Facility	No	Purpose	Remarks
Australia	Steritech Pty Ltd	3	Commercial	To replace gamma with X-rays very positive response
	ANSTO	1	Research	
	Narangba in South East Queensland	1	Phytosanitary	Approved to add a new X-ray facility
	A dedicated treatment facility in Southern Australia	-	Phytosanitary	Fruit fly regulations resulted in new interest
Bangladesh	85 kCi dry type Co-60 irradiator in Dhaka		Research + commercial	1200 MT food in addition to pharmaceutical products
	Gamma irradiator of 350 kCi installed in Dhaka		Commercial	For promoting international trade of irradiated food of spices+foods
China	• China began its research about food irradiation in 1958. • Irradiation facilities can be divided into four types: ✓ Below 300,000Ci Co-60 ✓ Above 300,000 Ci Co-60 ✓ EB ✓ X-ray			Own pros and cons on technology and economy, but X-ray is the direction for further development. Co-60 below 300,000 Ci is unstable, easy to occur accidents.
	Irradiation in Tianjin	1	Research	1st established
	7.5MeV/5Kw accelerator		Research + Commercial	Several goods for quarantine purpose
	Irradiators (Co 60) over 2 million Ci and EB facilities	>200	Commercial	By 2000 < 50, 2005>100 2009>200

India	Food irradiators	16	Commercial	Ten plants in the private sector
	MoUs signed for more food irradiation facilities	7 (Proposed)	Commercial	New At Ahmedabad (Gujrat state), Gurgaon (Haryana state).
Indonesia	Cobalt-60 and electron beam sources	One each	Research	By National Agency for Nuclear Energy (Local name: BATAN)
	-	-	Phytosanitary purposes	BATAN ready for low dose application
	Gamma Irradiator	1	Medical devices/dried foods	private industry (local: PT. Rel-lion Sterilization)
	Gamma irradiators	2	Commercial	Work initiated to install in East Java and South Sulawesi
Malaysia	Irradiation facilities	3	Commercial	Already in operation
	Irradiation facilities	2	Commercial	To be commissioned at Sepang Selangor and Kuching, Sarawak soon
	Electron beam of 10 MeV facility	1	Commercial	Proposed in 11th Malaysian Plan
Myanmar	Gamma irradiator	1	Category I	Just one
New Zealand	Irradiation facility		Commercial	Unsuitable for commercial irradiation of food
Pakistan	Gamma Irradiators	2	Research	At Peshawar in 1983 & 2012
	Co-60 irradiator	2	Commercial	PARAS, Lahore for Medical (1987)/Food Items (2009)
	EB & Co-60	4	Commercial	Approved in Karachi, Peshawar, Multan and Quetta
Philippine	irradiation facility		Semi-commercial	Co-60, 120 kCi source, by PNRI
	Electron beam facility with 2.5 MeV100 KW		Commercial	In 2012, adjacent to gamma irradiation facility in the PNRI premises

Republic of Korea	gamma irradiation facilities	2	Commercial	Food irradiation
	EB	3	Commercial	3 companies are in progress for the business of food irradiation
Sri Lanka	Need irradiation facility for the purpose of sterilization of foods like tea, spices (cinnamon) & medical products			
	Gamma irradiation of 5000 Ci	1	Research	Atomic Energy Authority and University of Colombo purposes
	Gamma irradiation plant	1	Medical products for export	A private foreign company installed in the Biyagama Economic Processing Zone
	Gamma irradiation facility (250 kCi) in near future	1	Semi-commercial multipurpose	Will also conduct R & D
Thailand	Food irradiation facilities having cobalt-60 sources	3	• Research + Commercial	○ TINT ○ Synergy Health Ltd. ○ Sterigenics (Thailand) Ld ✓ 22 food manufacturers
Vietnam	1st irradiator at Hanoi		Research	In 1992, Agency grant
	Gamma irradiators	7	Commercial	3 belong to VINATOM and others to private companies
	EB accelerator, converted to X-ray	1	Commercial	
	E-beam facility	1	Commercial	
	More irradiators in the future	-	Sterilization of healthcare products, food /dragon fruit	To set up in the middle of Vietnam (Binh Thuan and Da Nang provinces)

Table 7. Characteristics of The Irradiators in Vietnam

Location of Irradiation Facilities in Vietnam

Le Thi Dinh - VAEI

Ha Noi Irradiation Center
(Co-60 Irradiator)

An Phu Co., Ltd
(2 Co-60 Irradiators)

Son Son Co., Ltd
(Linac Accelerators)

VINAGAMMA
(Co-60 Irradiator)

Thai Son Group
(Co-60 Irradiator)

Electron Beam (EB)/X-ray Accelerator

- Belongs to a private company (Son Son Co., Ltd.)
- Type: Linear accelerator (Sure Beam)
- Established in 2003, EB power: 2 X 150 kW Width of EB scanning: 105cm
- Status: High efficiency
- Purpose: Gemstone irradiation, food preservation and fresh fruit quarantine treatment (dragon fruits)

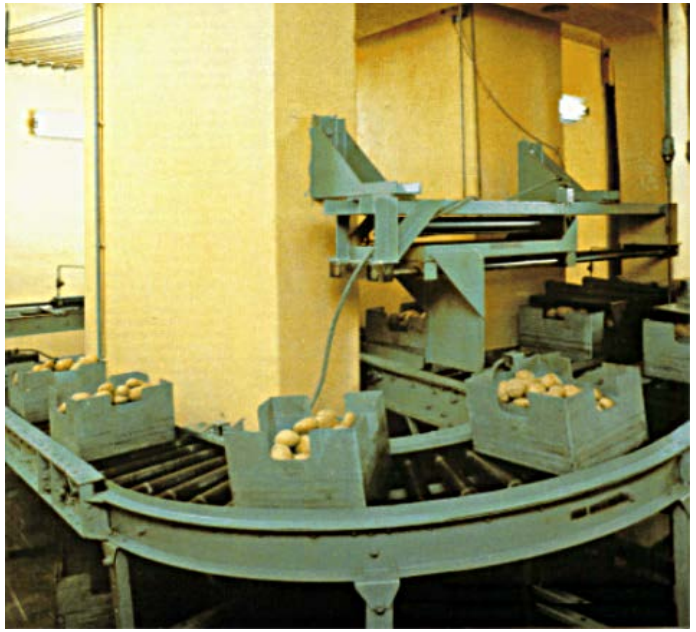
PNRI Co-60 Pilot Semi-Commercial Facility -

Newly established Co-60 source 24000 curies

Thai Irradiation Center (TIC)
Thailand Institute of Nuclear Technology,
Ministry of Science and Technology

Food Irradiation Facilities: Existing

Radiation Processing Plant, Vashi, Navi Mumbai	400 kCi	Spices & dry Ingredients
ISOMED (BRIT), Mumbai	350 kCi	do
SARC, SIIR, Delhi	450 kCi	do
VIKIRAN, M/s Organic Green Foods Ltd., Kolkata	280 kCi	do
STERICO, AV Processors Pvt., Ltd., Mumbai	350 kCi	do
Universal ISOMED, M/s Universal Medicap Ltd., Vadodra	540 kCi	do
M/s Microtrol Sterilization Services Pvt. Ltd., Bangalore	500 kCi	do
KRUSHAK, BRIT/BARC	275 kCi	Mango
M/s Agrosurg Irradiators Pvt. Ltd., Mumbai	250 kCi	Spices & dry Ingredients



Irradiation Facilities in Malaysia

Present

- SINAGAMA (Medical, agriculture commodities)
- ISOTRON - (Medical & food)
- ANSELL Sdn Bhd – (Medical)
- STERILGAMMA Sdn Bhd- (Medical)
- ELECTRON BEAM Sdn Bhd - (Medical)
- MEDITOP Corporation(M) Sdn Bhd - (Medical)

Near Future

SG eBeam Sdn Bhd (Food, Fruit) - Ebeam (received Technofund grant)

Quantity

Country	Year	Quantity	Commodity	Remarks
Australia	2011-12	1262 ton	mangoes	Highest volume since exports began in 2004
		48 ton	lychee	Exports continued but volume still low
	2012-13	341 ton	tomatoes	For export to NZ and within Australia
		48 ton	capsicums (bell pepper)	
	• Volumes low but important as NZ Market was closed to Australian exporters when restrictions on chemical treatments enforced. • New Zealand imports approximately 1000 ton of irradiated Australian fruit/year since 2004 and the volumes have slowly been increasing. • Exports of irradiated produce to Malaysia continued. • Australia is negotiating with several countries including Thailand and the US to expand the use of irradiation. • Domestically the use of irradiation is still on small scale due to the availability of cheaper chemical treatments. • However, dimethoate and fenthion treatments currently under review and some uses have already been restricted. • Exports of irradiated fresh produce in last years are given in Table 8. • Irradiated fresh produce imported by New Zealand are given in Table 9.			

Table 8. Australian Exports of Irradiated Fresh Produce (Tonnes)

Season	2004-05	2005-06	2006-07	2007-08	2008-09	2009-10	2010-11*	2011-12
Mango	19	129	201	346	585	1,095	620	1262
Papaya	-	-	12	1	-	-	-	
Litchi	-	5	10	20	57	110	15	48
To NZ	19	134	223	367	630	1142	614	1222
To Malaysia	0	0	0	0	12	63	21	88
Total Volume	19	134	223	367	642	1205	635	1310

Table 9. Irradiated Fresh Produce Imported by New Zealand

Season	2004-05	2005-06	2006-07	2007-08	2008-09	2009-10	2010-11	2011-12
Mango	19	129	201	346	585	1095	620	918
Papaya	-	-	12	1	0	0	0	0
Litchi	-	5	10	20	57	110	15	132
Total	19	134	223	367	642	1205	635	950

Country	Year	Quantity	Commodity	Remarks
Bangladesh	1994-98	1200 MT	dry fish, fruits, beef casing, bean/pulses, turtle meat, macaroni	
	2011	25.45 MT	Coriander, cumin, turmeric, chilli, peanut, herbal teas, *Jhalmuri* (mixed pupped rice with hot spices), spirulina (herbal product) and protein-90 (food supplement)	Export of irradiated spices to the US, Japan and Australia & pea nuts and popped rice to the Middle East initiated
	2012	41.13 MT		
	up to October 2013	41.14 MT		
	Annually	30,000 MT	Fruits and vegetables	Exported to Middle East and Europe

- The China plays positive role for food irradiation at commercial level
- In 2010, irradiated 200,000 ton food including garlics, spices, dehydrated vegetables, corns, pickle chicken legs, and aquatic products etc.
- Irradiation is mainly used for quarantine purpose.
- In 2011, China imported 29935 ton fruits from Thailand (longan, lychee and mango).

Country	Year	Quantity	Commodity	Remarks
Indian	Since 2000	18,338 ton	Spices and dry ingredients for microbial decontamination	plant at Vashi, Navi Mumbai, under the Department of Atomic Energy
	last six years	281 MT	Mango	Expor to USA by KRUSAK facility at Lasalgaon, Maharashtra
	2011-2012	220 MT	Fruits	-do-
Indonesia			Fresh tropical fruits like mango, mangosteen, pineapple, strawberry and fresh vegetables	One of high potential countries for the export to Singapore, Malaysia, China, Japan, Netherland, France and Middle East countries
	Intervention studies of irradiated RTE food on 30 school children given during breakfast time with age ranging from 10 to 12 years old were conducted.			
Japan	2010	6246 ton	Potato	for almost 40 years at Shihoro Irradiation Centre at Hokkaido
	2012	6,000 ton	Potato (Fig. 2)	Sold with appropriate labelling at retail outlets
	2012	Ministry of Health initiated research on irradiation treatment of meat products		
Republic of Korea	2009	2,500 ton	Spices or dried vegetables	Irradiated products in Korea are shown in Fig. 3.

Country	Year	Quantity	Commodity	Remarks
Malaysia	2010	785 ton	Spices, herbs, vegetable seasonings and cocoa powder etc. on commercial basis	Sinagama being the only facility. No phytosanitary treatment or traded.
	2011	602		
	2012, until September	449		
	Since 2010	-	Harumanis mango	Export to Japan - VHT
	Spices and herbs irradiated from 2009 to 2013 decreasing from 826 to 408 metric ton due to source depletion.			
Mongolia	Since 2007	-	Crop and vegetable	Supply increased, need to adopt irradiation.
Myanmar	Food irradiation activity has been initiated		agricultural products	Phytosanitary treatment
Pakistan	2009	400 tones	vegetables, spices, fruits, dry milk, herbs, meal ready to eat (MRE) packets etc	0.6 – 10 kGy for sanitary and phytosanitary treatment by PARAS FOODS (pvt) Ltd
	2010	524		
	2011	597		
	2011	503		
	2013 till September	350		
Philpine	2009	430 ton		PNRI irradiation facility
	2010	460		
	2011	714		
	2012	850		

Table 10. Thailand Export Volume of Irradiated Fruits to USA (kg)

Fruit	2007	2008	2009	2010	2011	2012	2013 (Oct)	Total
Longan	147,792	294,992	1,212,134	410,352	268,836	392,839	345,328	3,072,273
Lychee	0	0	0	17,971	0	33,524	0	51,495
Mangosteen	0	48,706	481,572	330,154	268,836	411,941	335,671	1,876,880
Rambutan	0	3,200	24,270	8,050	6,760	0	0	42,280

Table 11. Foods Irradiated by Vinatom (Updated Data from VINAGAMMA & HIC)

Irradiated foods (tons)	2008	2009	2010	2011	2012
Frozen sea-foods (fishes, shrimps, frog legs, squids, octopus…)	3.500	4.300	3.000	2.200	1.600
Dried foods (fishes & squids)	61	45	40	45	40
Powders (garlic, ginger, pepper, onion)	1.200	1.050	1.000	1.020	1.600
Dehydrated vegetables (onion, pumpkin, paprika, carrot, seasoning…)	85	80	65	80	80
Starch, functional Foods and others	10	10	15	20	20
Total (±10%)	4851	5485	4120	3365	3340

- There are small amounts of frozen shrimps, dried fishes, dehydrated vegetables and most of functional food were irradiated at Hanoi Irradiation Center, where the main products are *traditional herbs and drugs.*

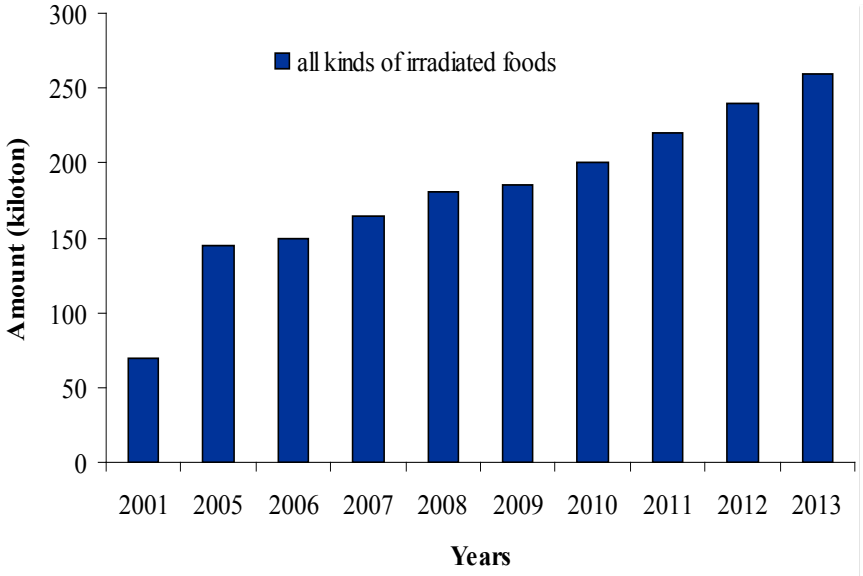


Fig. 1. Development and expansion in China

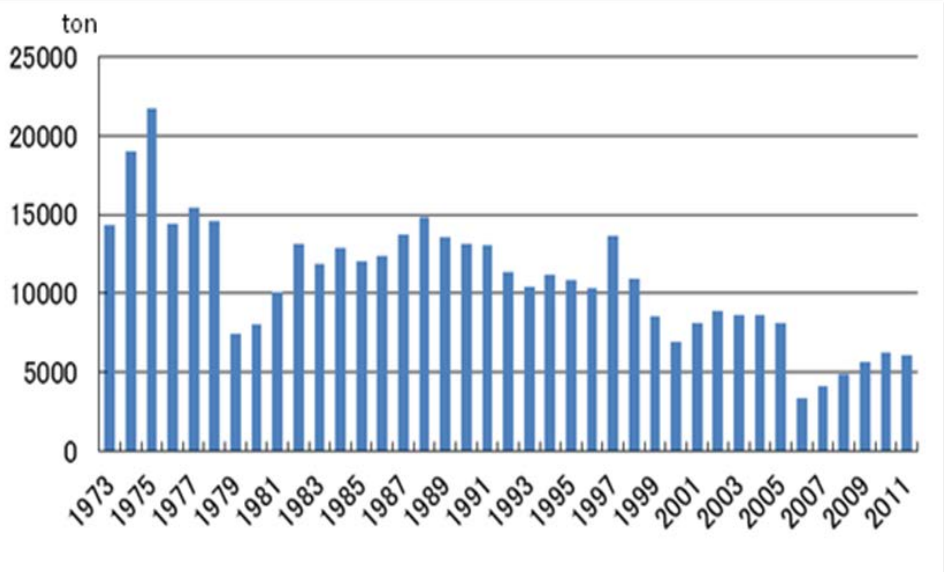


Fig. 2. Quantities of irradiated potatoes in Japan during 1973 – 2011.

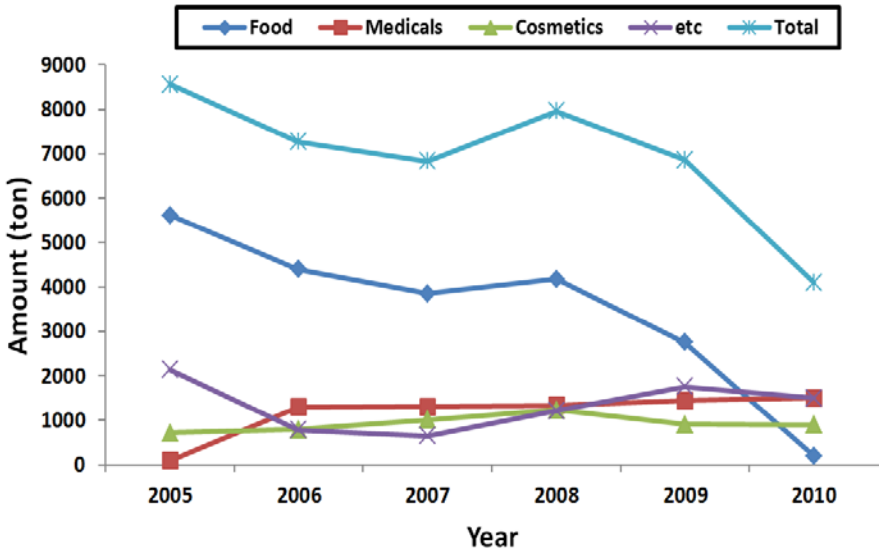


Fig. 3. Quantities of irradiated products in Korea

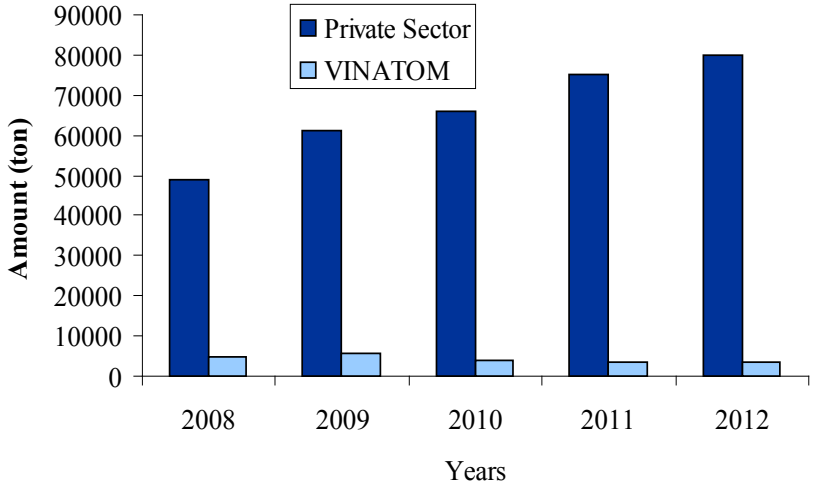


Fig. 4. Present food irradiation in Vietnam

Country	Year	Quantity	Commodity	Remarks
Vietnam	2012	80,000 ton	Food	Irradiated food not available in domestic market. All exported.
EU, US & Asia Pacific region	2009	380,000 ton	Food	For human and animal consumption
EU	2011 - 2012	8,100 ton	Food	Figure generally stable in the period
	2002	20,000 ton	Food	Estimated quantity had fallen.
	2006	15,000 ton	Food	
Belgium	-	5030 ton	frozen frogs' legs, poultry, seafood and spices/seasonings	Principal products irradiated
Netherlands	-	1573 ton	Dehydrated vegetables, spices and herbs, poultry, frog parts, egg white and frozen shrimp	Principal products irradiated
France	-	695 ton	poultry, spices and frozen frogs' legs	Principal products irradiated
UK	-	-	-	No food was irradiated

Table 12. Eligible Commodities and Irradiated Imports into The USA.

Ghana	Eggplant, Okra, Pepper
Hawaii	Abiu, Atemoya, Banana, Breadfruit, Capsicum spp., Carambola, Cucurbita spp., Dragon fruit, Eggplant, Jackfruit, Litchi, Longan,mango, Mangosteen
India	Mango
Malaysia	Rambutan
Mexico	Carambola, Clementine, Grapefruit, Guava, Mango, Manzano, Sweet lime, Sweet orange, Tangelo
Pakistan	Mango
S. Africa	Grapes, Stone fruit, Pear, Persimmon
Thailand	Litchi, Longan, Mango, Mangosteen, Pineapple, Rambutan, Dragon fruit
Vietnam	Dragon fruit, Rambutan

Table 13. A Brief Summary of Imports into The US (Tonnes)

Country	**Fruit**	**2008**	**2009**	**2010**
India	Mango	275	130	195
Thailand	Longan (mainly)	1700	1890	1800
Vietnam	Dragonfruit	0	100	850
Mexico	Guava	257	3521	9121
	Grapefruit	0	67	101
	Mango	0	0	239
	Sweet lime	0	0	600
	Manzano pepper	0	0	257

Source: IFST (2013)

Mangoes
Citrus
Apples
Peaches
Dry fruits and dates
Rice
Vegetables
Medicine herbs & spices condiments
Wild edible mushrooms
Seafood

Special Fruits in Vietnam

Special Fruits in Pakistan

Thailand

Bilateral Agreements

- Australia achieved new protocols through bilateral agreements with New Zealand and Malaysia for phytosanitary use.
- Negotiations underway for approval between Australia with India, Thailand, Pakistan and the United States (mango and lychee).
- New Zealand and China inked MoU for phytosanitary requirements of export of mango and rice in 2003 and 2005, respectively.
- NZ also inked MoU/Agreements with
  - (a) Mexico for the export of rice from Pakistan
  - (b) Iran for mango and citrus export
  - (c) Republic of Uzbekistan Mauritius for sanitary and phytosanitary issues
  - (d) Republic of Argentina for SPS issues and exchange of information on plant quarantine
  - (e) Jordan for mango export
  - (f) Russian Federation for export of citrus and rice is in progress
  - (g) Lebanon for the export of mango
  - (h) Japan for commercial export using VHT
- Phytosanitary protocol is finalized in 2009 for the export of mango from Pakistan to USA subject to irradiation treatment.

- The APHIS, USDA accept irradiation as phytosanitary measure for import of fresh fruits and vegetables.
- Seven fruits i.e. dragon fruit, litchi, longan, mango, mangosteen, pineapple, rambutan are exported from Thailand to US treated with irradiation in Thailand at the D(min) of 400 Gy but <1 kGy and subject to joint inspection by APHIS and NPPO of Thailand.
- Effective from July 23, 2007 and dragon fruit from Oct. 4, 2011.
- The 1st shipment of fresh fruits from Thailand to US on Nov. 1, 2007.
- Fresh fruits in Malaysia exported to Brunei, Singapore, Hong Kong & UAE.
- Malaysia looking toward new market like China, Japan, Australia and US.
- After joining WTO at the end of 2006, Vietnam established bilateral agreement with US for red dragon fruits with generic dose of 400 Gy.
- Nearly 2000 ton of red dragon fruits reached to US from Vietnam in 2013.
- Some other fruits from Vietnam such as litchi, mangoes, durian, plum got a good opportunity to export to US, EU, Japan and Australia.

Consumer Slow Response

- The adoption of irradiation technology is so slow because:
  - It does not always kill the target pest immediately
  - Alternative treatments cheaper/easier to apply, may not be safer
  - Lack of awareness
- The steps required to exploit the benefits of irradiation involve standardisation, communication and education.
- WHO, FAO and IAEA already working on this issue.
- Surveys carried out (mostly in USA) to assess consumer attitudes (Bruhn & Schutz, 1989; Resurreccion *et al*, 1995; Fox 2002).
- Many consumers believe that it makes food radioactive.
- But when they given a chance to try irradiated products, they liked to accept technology.
- Market trials conducted successfully.

Awareness Programmes

- Based on consumer survey on food irradiation, the brochure and video clip published for improving the public acceptance e.g. Korea.
- Irradiation technology applied to special purpose e.g. space foods & patient meals, making irradiation as common decontamination method in industry.
- PAEC and IAEA jointly organized Int. Symposium on Commercial Applications of Food Irradiation at TINT, Bangkok, Thailand from Feb. 20-24, 2012. To train the trainers program.
- PAEC and IAEA jointly organized Workshop on Commercial Exploitation of Food Irradiation Technology in Pakistan – Potentials, Opportunities and Challenges at Lahore, Pakistan from Oct. 2-3, 2013.
- Seminars/symposia arranged at universities and institutes in India. IAEA organized “RCA Training Course on Train the Trainer for Quarantine Inspectors” at Kajang, Malaysia, 19 - 23 Sept. 2011.
- Linkages and partnerships with the different food associations, exporters and academe have been undertaken in Philippines.

Conclusion

- The EM Meeting successful to promote awareness of irradiated food amongst control authorities/regulatory policy in this area.
- Irradiation can be used as SPS treatment/shelf life extension.
- To further enhance irradiated trade in the region, information was shared.
- Sanitary applications matured and very promising, the commercial aspects in many RCA/MSs especially China & Vietnam but slow for other MSs.
- The applications rapidly accepted in the region, but to different extents.
- The phasing out of chemical treatment under the Montreal protocol increased the importance of food irradiation.
- Some MSs still need to develop their own regulations and guidelines to start the application of irradiation as a phytosanitary treatment.
- Public awareness for food safety using irradiation technique and more irradiation facilities are needed to be established.
- The experiences sharing, information exchange and required training under the project would significantly benefit its MSs on food safety and food trade.
- It is appropriate for the IAEA to provide technical support, especially on Quality Assurance Procedures, Standard Operating Procedures and Training Manuals.

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Thank you