



## Leadership program

Developing an expanded talent pool for the irradiation industry

**Reims, France - April 26, 2023**



**Food irradiation and phytosanitary irradiation**

**Yves HENON**

**Have you ever eaten  
irradiated food ?**

# POTENTIAL BENEFITS OF FOOD IRRADIATION

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## IMPROVE FOOD SAFETY



Replacement of harmful chemicals  
Inactivation of foodborne pathogens

## IMPROVE BIOSAFETY



Prevents spreading of invasive pests

## REDUCE FOOD WASTAGE



Improvement of microbial quality  
Extension of shelf life

## IMPROVE FOOD SECURITY



Reduction of post-harvest losses

# Pasteurisation and sterilization by irradiation

Pasteurisation: mainly to render products safe by eliminating undesirable microorganisms

Sterilisation: mainly to render products safe by eliminating all microorganisms

Among other methods, chiefly heat treatments, irradiation has several advantages:

- No temperature increase
- Applicable to frozen or powdered products
- Through final package
- Only one control parameter: dose

Effects on microorganisms through inactivation = Transformation that renders them unable to multiply and therefore produce colony forming units (CFUs) when cultivated

# Radiation pasteurisation of food

(Radicalisation)

Aim: Inactivate foodborne pathogens: *Salmonella*, *Listeria*, *Campylobacter*, *E. coli*...

Their low  $D_{10}$  ( $\sim 1 \pm 0,5$  kGy) allows treatment at low doses ( $< 5$  kGy) that have minimal effects on nutrients and sensory qualities

Advantages of irradiation:

- No temperature increase
- Applicable to frozen or powdered products
- Through final package
- Only one control parameter: dose



# Radiation pasteurisation of food

(Radurization)

Many dried ingredients used in the food industry (but also pharma and cosmetic) are natural products contaminated with microorganisms, most of the time non pathogenic.

*Seasonings, herbs, spices, colors, seeds, some products of animal origin...*

Good Manufacturing Practice require their microbial to be reduced before further processing,

Irradiation effective to inactivate bacterial spores, moulds and fungi

Doses: 4 to 10 kGy (doses higher in absence of water)

Main application: spices used by the food industry



# Irradiation as a phytosanitary treatment

Phytosanitary treatments of plant products aim at preventing the introduction of certain pests in areas where they are not present

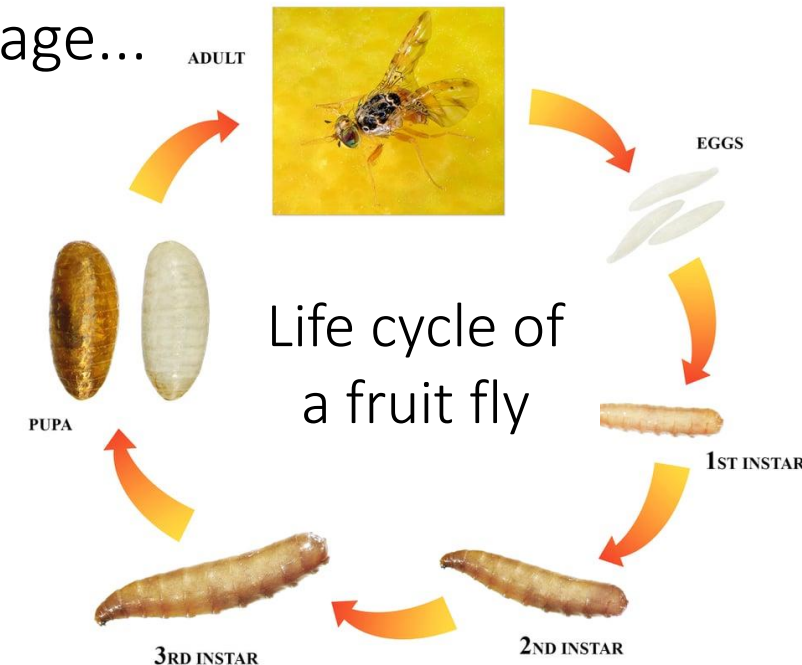


Irradiation is an alternative to other phytosanitary treatments (methyl bromide fumigation, cold treatment, hot water dipping...)

Biological damage depends on dose, species, development stage...

Response in targeted pest may be:

- Mortality
- No evolution to next development stage  
*e.g.* eggs do not hatch, non-emergence of adults
- Inability to reproduce  
*e.g.* sterility of adults or F1 (first filial generation)

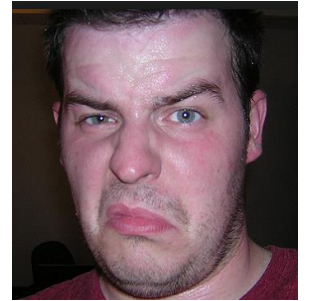




# Irradiation as a phytosanitary treatment

Specificity of irradiation among phytosanitary treatments:

Irradiated produce acceptable even if live insects are present  
*change of paradigm for biosecurity agencies*



Confidence in irradiation treatment based on:

- Research to determine minimum necessary dose (usually ~50-400 Gy)
- Validity of dosimetry to ensure minimum dose was delivered
- Safeguarding measures to prevent (re)infestation

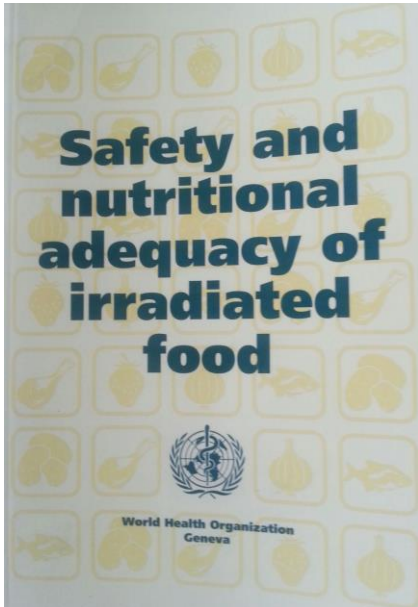
Use rapidly growing in America and Australasia  
~ 80,000 tons traded in 2022





**Would you eat  
irradiated food ?**

# IRRADIATED FOOD IS SAFE



Does not make food radioactive

No particular toxicological, microbiological or nutritional problem

Safety more extensively researched than for any other process

Changes minimal: not easy to tell if a food has been irradiated



U.S. Department of Health and Human Services



**U.S. FOOD & DRUG  
ADMINISTRATION**

## Is Irradiated Food Safe to Eat?

The FDA has evaluated the safety of irradiated food for more than 30 years and has found the process to be safe. The World Health Organization (WHO), the Centers for Disease Control and Prevention (CDC) and the U.S. Department of Agriculture (USDA) have also endorsed the safety of irradiated food.

# Mention of irradiation on label mandatory



The RADURA logo

**Do you agree that the mention  
'irradiated' should appear on  
the label of irradiated food ?**

## Yes, the mention 'irradiated' should be mandatory

- Right of consumers to know
- Right of consumers to refuse irradiated food

## No, the mention of 'irradiated' should not be mandatory

- Most people do not understand 'irradiated'

IRRADIATED

RADIOACTIVE

CONTAMINATED

- The word *irradiation* is actually misleading
- Why must irradiation be indicated and not other physical treatments or chemical fumigation ?
- In a list of ingredients, it looks like a warning
- Statement of benefits must be added



# CONSUMERS' PERCEPTION



WHAT DO CONSUMERS THINK OF  
FOOD IRRADIATION ?



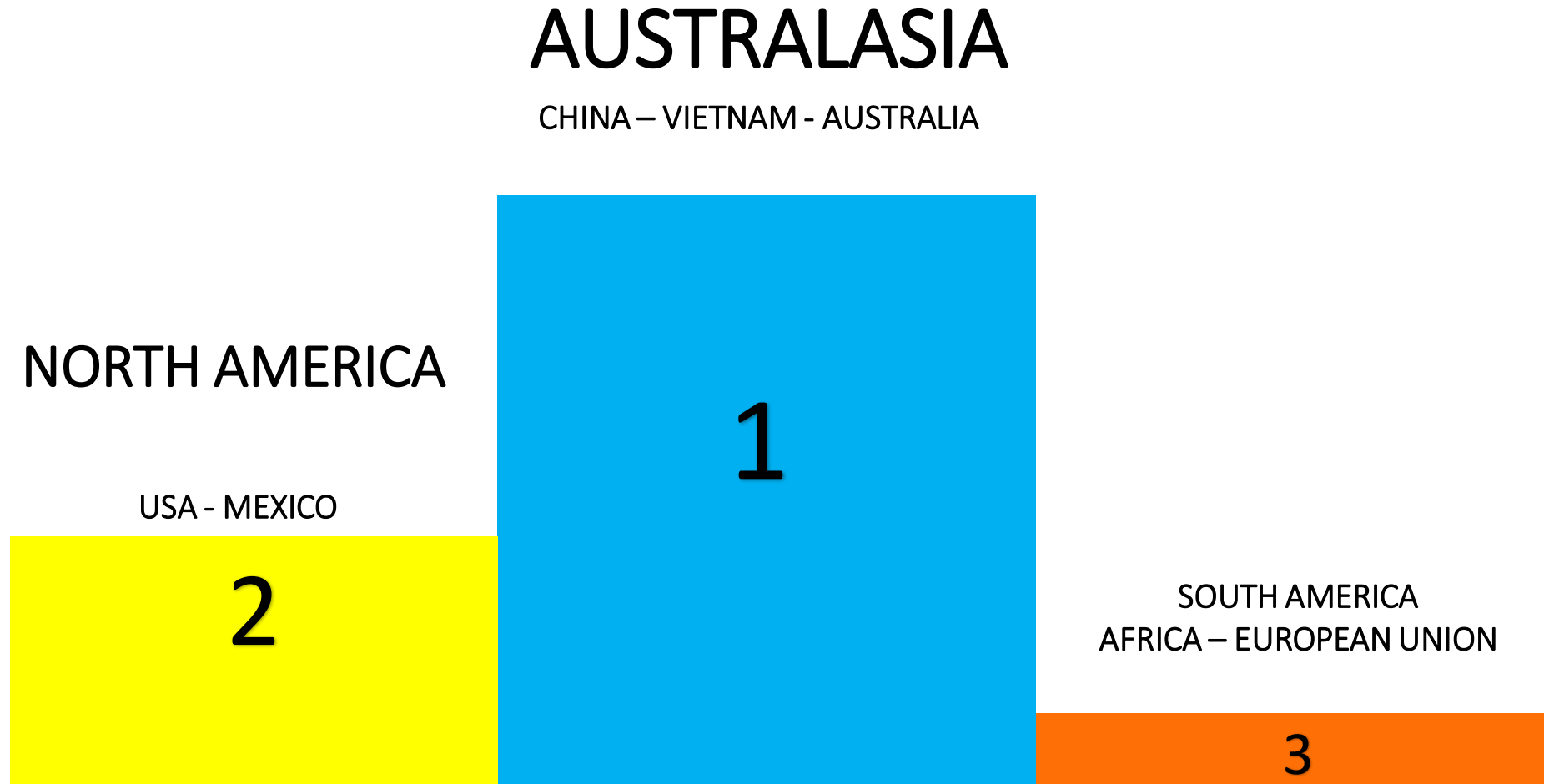
DO CONSUMERS BUY IRRADIATED  
FOOD ?

**YES** WHEN

- 1) REGULATORS ALLOW THEM
- 2) RETAILERS OFFER THEM



# COMMERCIAL USE OF IRRADIATION FOR FOOD



# CHINA

## 辐照食品 科普知识50问

50 Questions on  
Popular Science Knowledge of  
Irradiated Foods

高美须 于 洲◎主 编 ■

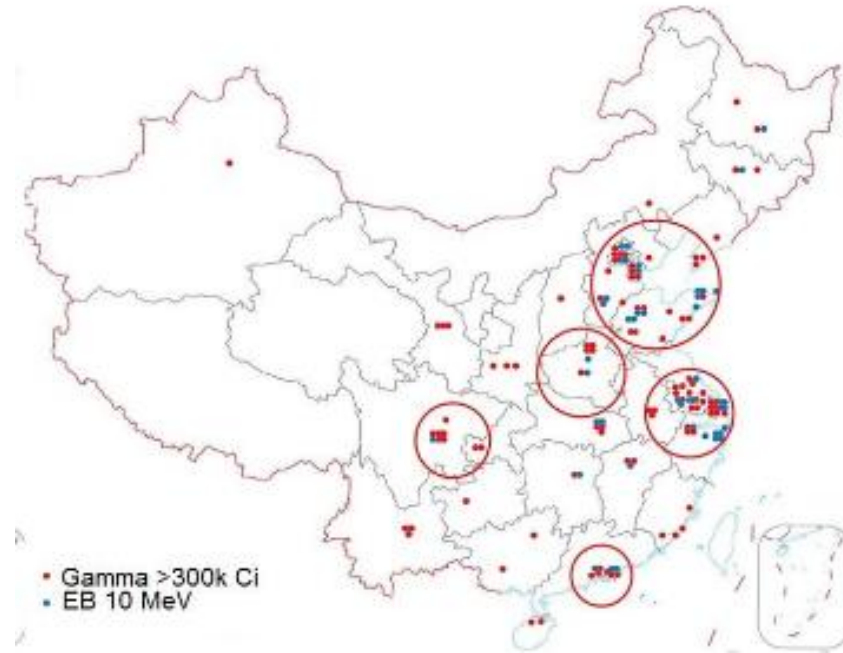


中国人口出版社  
China Population Publishing House  
全国百佳出版单位

## NUMBER 1 USER:

> 1 million tons of food irradiated

in ~ 100 gamma and electron beam  
irradiation facilities



# CHINA

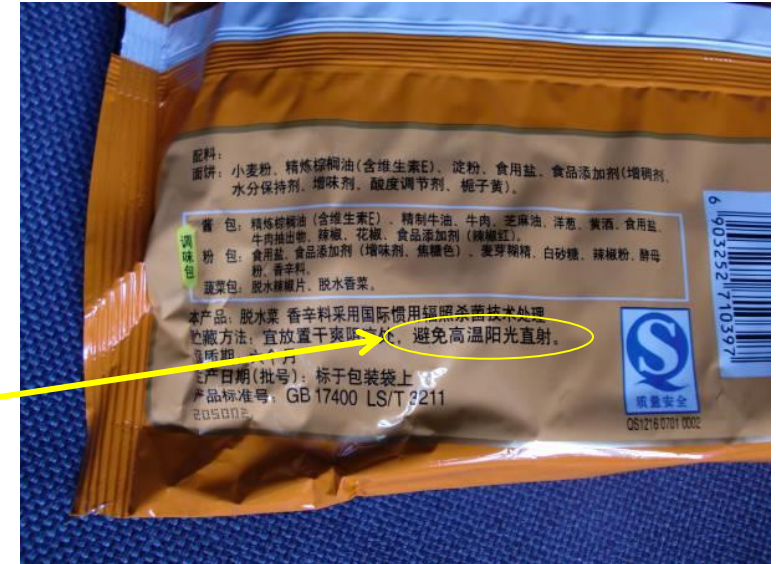
Largest volumes:

- Spices, condiments, sauces

> 250,000 tons / year

*Dehydrated vegetables and spices are irradiated  
according to international procedures*

*Irradiated seasonings in instant noodles*



- Garlic  
(China world # 1 producer and exporter)



- Pickled chicken snack

# CHINA

## Spicy pickled chicken feet / wings:

- Popular snack found in convenience stores across China.
- Irradiation allows minimum boiling for better texture
- Shelf-life at room temperature > 6 months
- 350,000 tons irradiated in 2018
- Two major manufacturers have own irradiator



← irradiated



# JAPAN



Permitted sprouting inhibition for potatoes

Built potato irradiation in 1973

Now ~ 6,000 tons / year



No new regulatory / commercial development in 45 years

# VIETNAM

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- Large irradiation capacity in multipurpose service centres
- Spices and seasonings, frozen fish and seafood, dried fish, etc.  
> 100,000 tons yearly
- Growth of phytosanitary irradiation accompanies rapid expansion of fresh fruit exports



In 2019, 5,100 tons of irradiated dragon fruit, dragon fruit, rambutan, longan, lychee, star apple, and mango to USA and Australia.





# THAILAND

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- Large irradiation capacity
- Spices and seasonings
- Spicy fermented pork sausage “*naem*” consumed uncooked, irradiated for safety

Snack sold in convenience stores across the country

- Tropical fruit (mango, mangosteen) exported to USA and Australia. Imports irradiated table grapes from Australia.



# INDIA



Irradiation permitted for a broad range of food products



25+ multipurpose gamma irradiators of which most treat modest volumes of spices and seasonings

3 gamma irradiators approved by USDA-APHIS for phytosanitary treatments



1,200 tons of mangoes exported to the US in 2019

# AUSTRALIA

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Spices and seasonings

Strict biosafety rules + ban on certain fumigants triggered use of irradiation as a phytosanitary measure. Strong government support.



Now second exporter of irradiated fresh produce after Mexico

Table grapes, mangoes and other fruit exported to New Zealand, USA, Thailand, Indonesia



# NORTH AMERICA

Significant volumes of spices

USA:

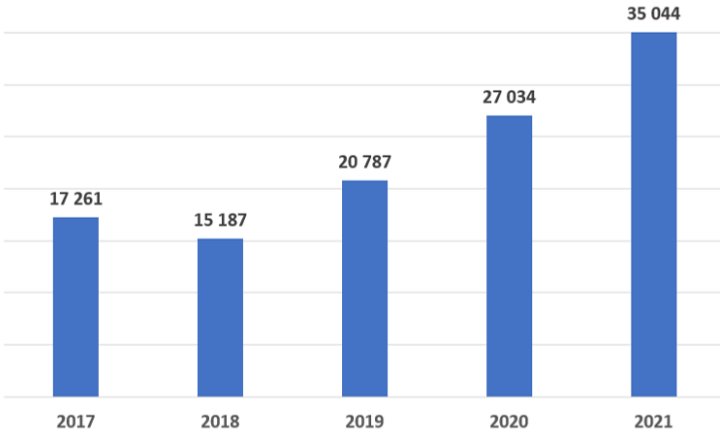
Limited volumes of hamburger meat irradiated

Main importer of irradiated fresh produce



Mexico:

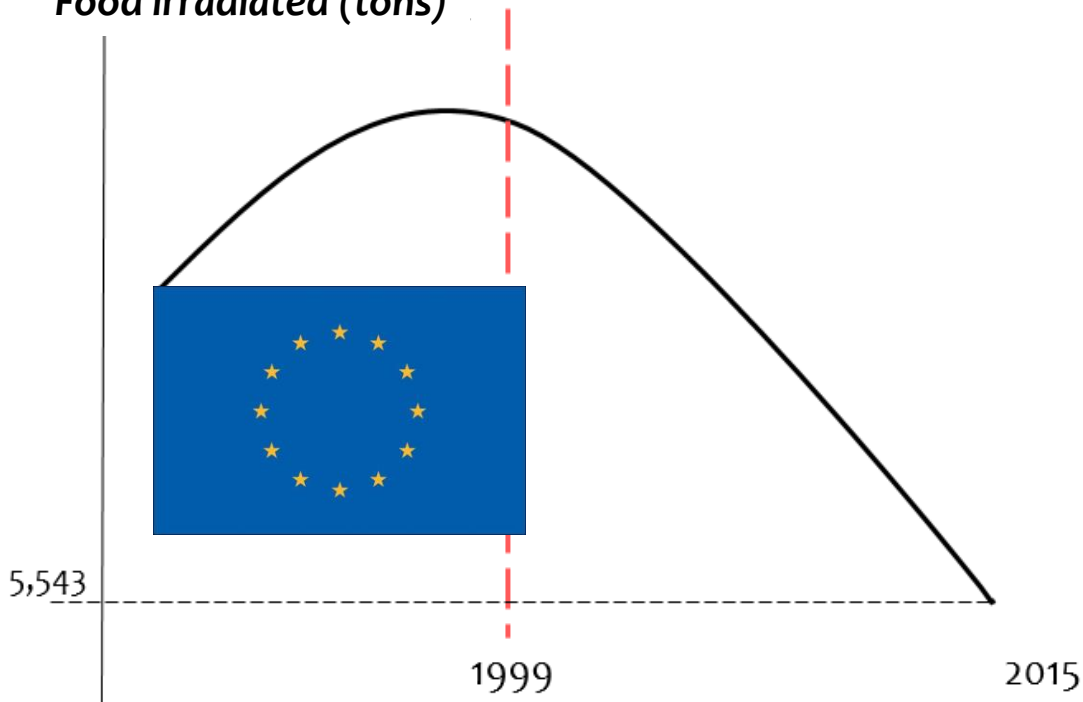
Largest exporter of irradiated fresh produce



Rank	Item	2020 Exports (tons)	Growth over 2019
1	Guava	11 622	-6%
2	Mango	10 043	+73%
3	Orange	1 495	+256%
4	Manzano peper	1 285	+18%
5	Pitaya	1 125	+21%
6	Pitahaya	596	+26%
7	Fig	445	0
8	Pomegranate	218	+257%
9	Carambola	120	+31%
10	Mandarin	85	+608%
Total:		27 034	+30%

# EUROPEAN UNION

Food irradiated (tons)



Volumes of irradiated food culminated at about 80,000 tons in 1998

1999 Directives permitted irradiation of spices and herbs only + a few national authorizations remained

Irradiation must be mentioned in list of ingredients for any amount

EU Directives unlikely to change in foreseeable future



# AFRICA

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Limited commercial use :

- Egypt: Spices



- South Africa: Spices

Imported honey

Freshly lifted garlic, onion, ginger

Table grapes, persimmons (export)



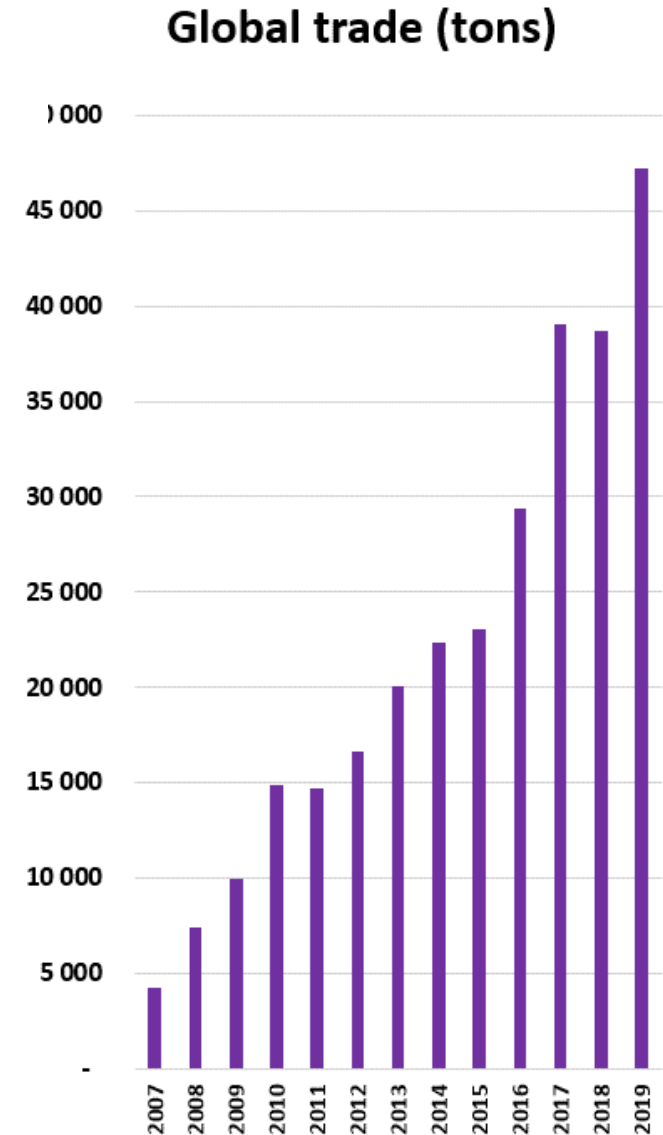
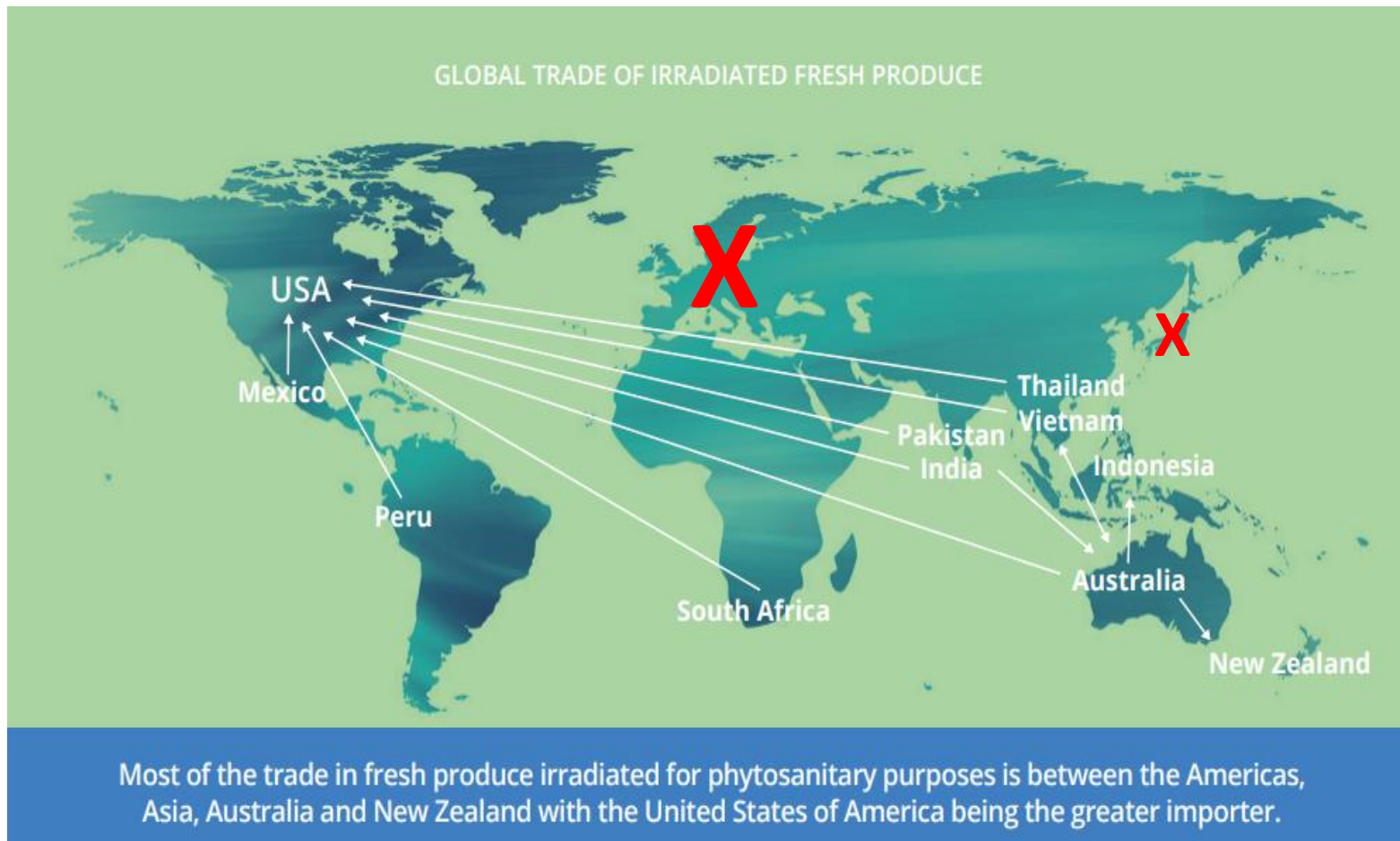
Irradiation capacity very limited

Other more sustainable technologies appear more needed and better suited than irradiation to improve food security in developing countries



# Use of phytosanitary irradiation increasing

## Trade of irradiated fresh produce



**Why is irradiation  
as a phytosanitary treatment  
growing when other uses of  
irradiation for food are stagnating?**

# WRAP-UP & OUTLOOK

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Slow uptake of irradiation as a food process

Niche applications – Potential remains largely untapped

Phytosanitary irradiation shows again that consumers buy irradiated products

Regulators and retailers might be the real obstacle to wider adoption

Unusual food technology as it is mostly applied off-site in third party facilities

Electron beam or X-ray machines that can be easily integrated in manufacturing or packing line might change the food industry's view on irradiation



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THANK YOU