



The Growing Market for Ionizing Technologies in the Americas

Prof. Suresh D. Pillai

National Center for Electron Beam Research

National Center for Low Energy Electron Beam Research

an IAEA Collaborating Centre for Electron Beam Research

Texas A&M University , Texas, USA

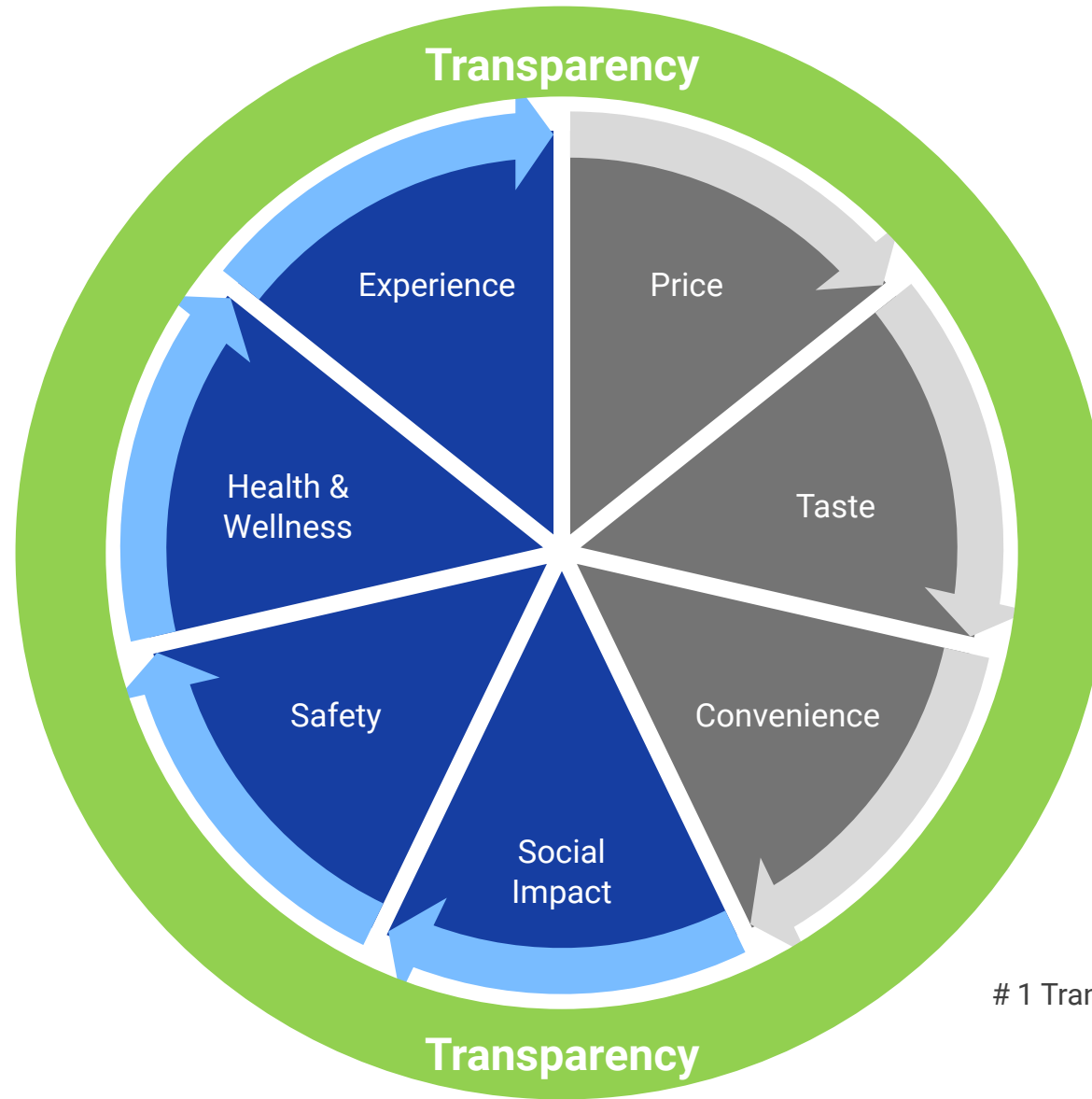


Presentation Outline

- Retailers and Consumers
- Current Markets
- Untapped Opportunities
- Technologies to accelerate adoption



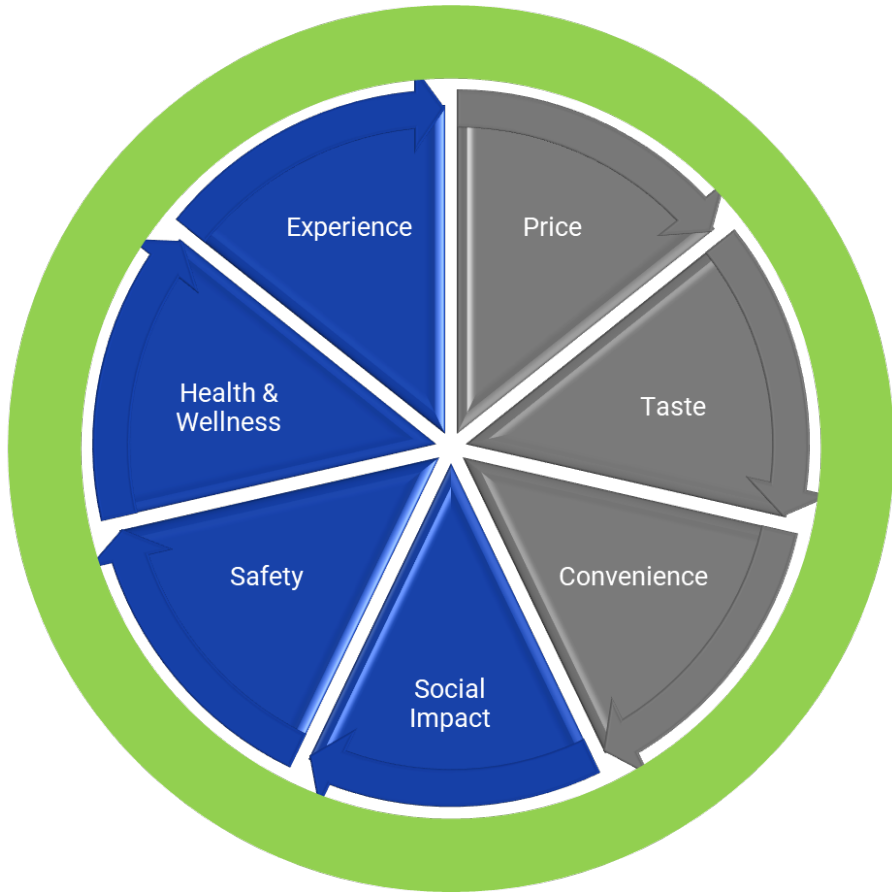
Retailers Listen to Consumers



1 Transparency (Clear labeling, 3rd party certification)



Retailers - High Value Proposition

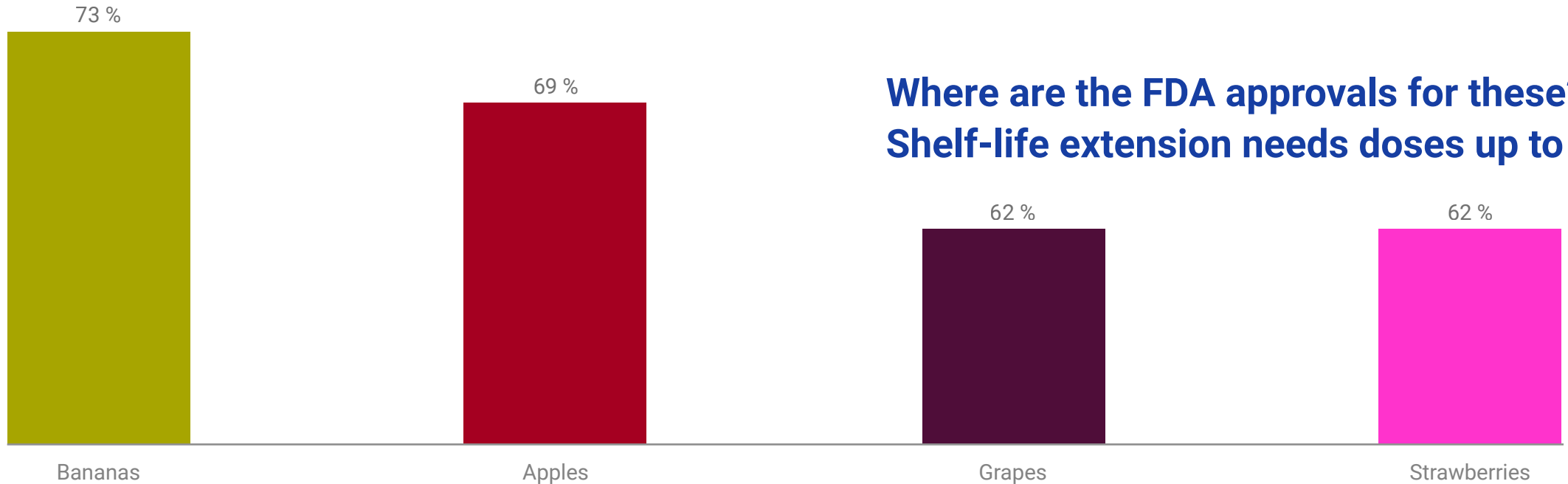


- Price
- Shelf-Life
- Quality & Condition
- Food Safety
- Waste Reduction
- Sustainability



Top 20 Fruits – US Consumer Trends

■ Bananas ■ Apples ■ Grapes ■ Strawberries



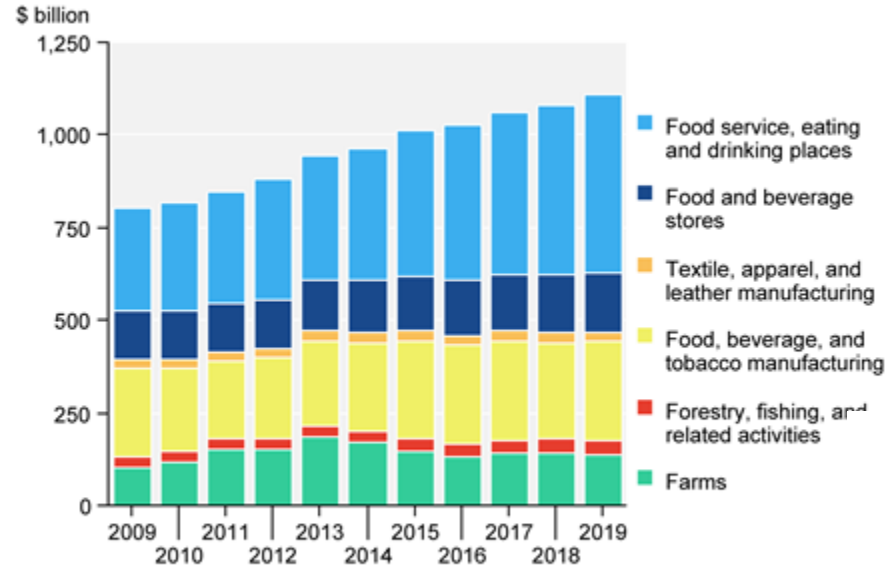
**Where are the FDA approvals for these?
Shelf-life extension needs doses up to 2kGy**

Source: The Packer, Fresh Trends-2018

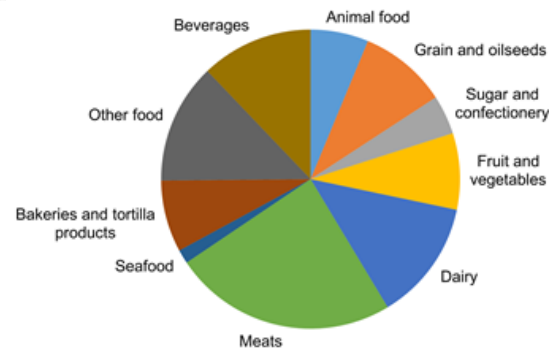


United States and Canada

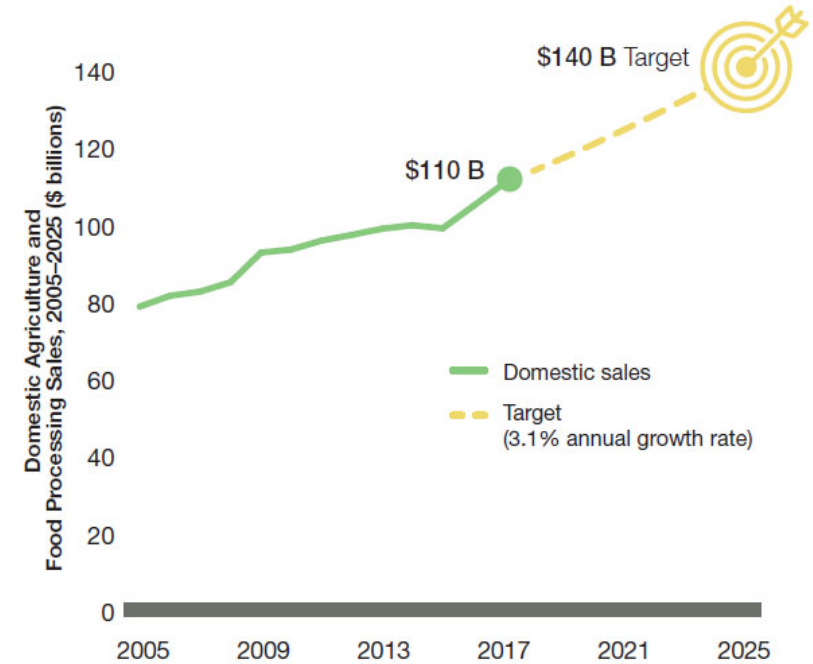
Value added to GDP by agriculture and related industries, 2009-19



Source: USDA-ERS 2020



Source: USDA-ERS 2020



Source: Statistics Canada and Agriculture and Agri-Food Canada (AAFC) calculations.

FDA approvals

- Fresh produce < 1 kGy
- Fresh & Frozen meats ≤ 7 KGy
- Spinach & lettuce : 4 kGy
- Spices: 30 kGy

- ✓ Market Demand vs Availability
- ✓ In sufficient Installed Technology Capacity
- ✓ Current approvals do not meet industry needs

Health Canada approvals

- Fresh & Frozen ground beef ≤ 7 KGy
- Spices : 30 kGy



Commodities Currently Approved for Phytosanitary Treatment for US Imports

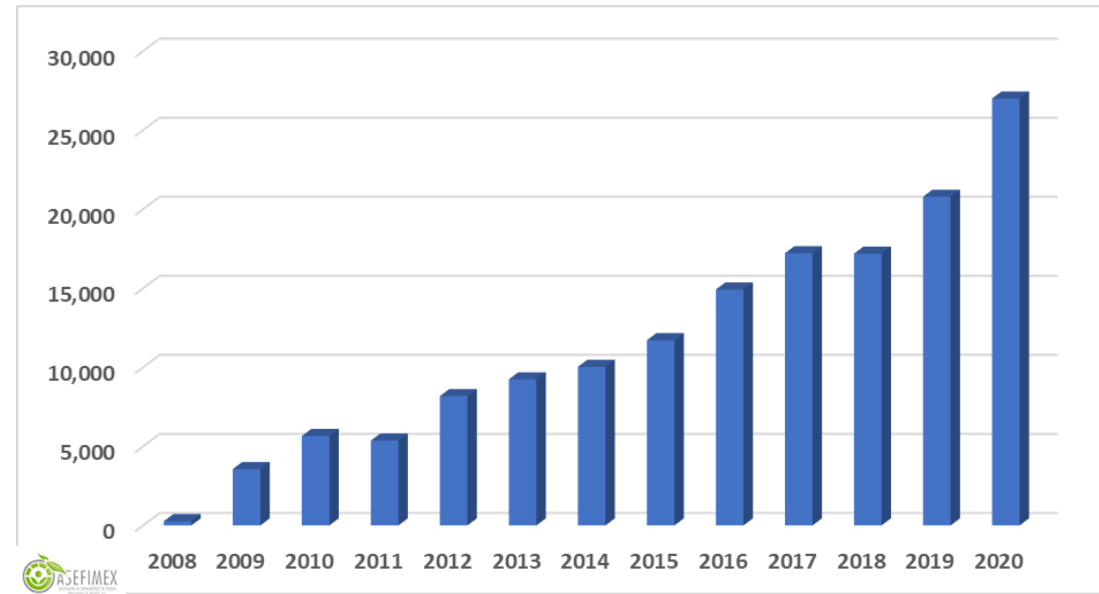
- **Latin American Countries**

- Chile : Blueberry and Grape
- Ecuador: Cape Gooseberry
- Jamaica: Mango
- Dominican Republic : Mango
- Peru: Blueberries, Figs, Pomegranates
- Grenada: Ambarella, Yellow Mobin, Purple Mobin
- St. Vincent: Ambarella
- **Mexico**: Guava, manzano pepper, mango, sweet orange, tangerine, clementine, mandarin, tangelo, sweetlime, dragon fruit, pomegranate, carambola, grapefruit



Mexico

- World only knows about Mexico's exports of fresh produce to the US by ionizing technologies
 - Mangoes
 - Guavas, etc
- **Country of Origin Treatment**
- or
- **Port of Entry Treatment**

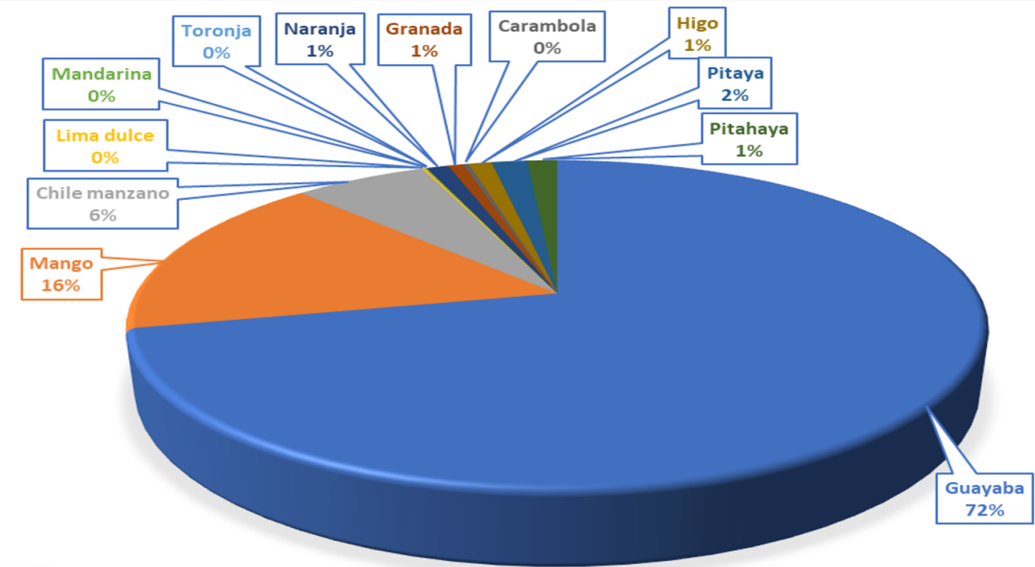
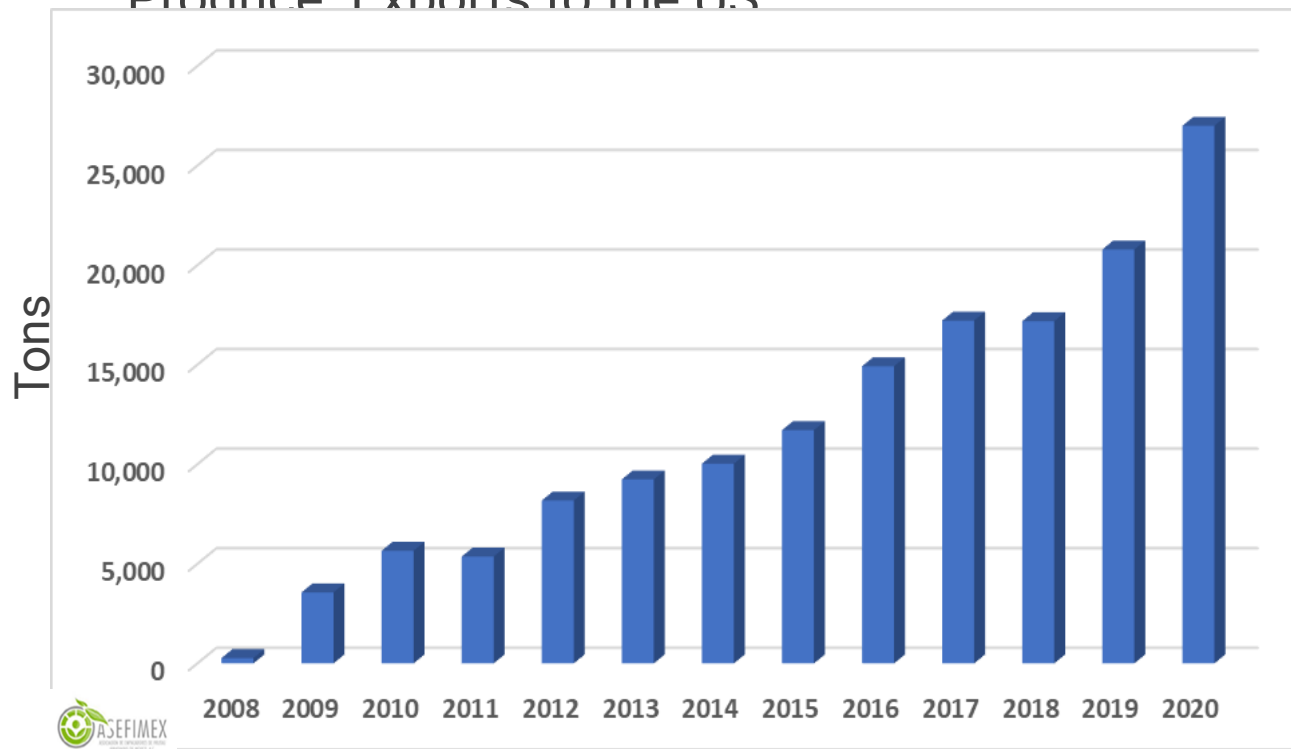


✓ **Major ramifications of choosing one approach over the other**



Ionizing Technology (IT) Market in Mexico

- Growth Trends in IT Processed Fresh Produce Exports to the US



Source: ASEFIMEX/eFoods Imports/e-agro Industrial

Mexico - Potential Market

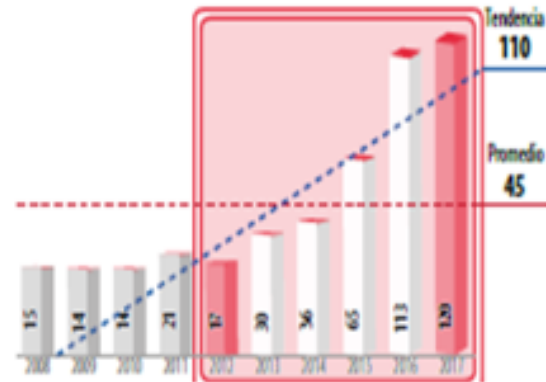


Berries

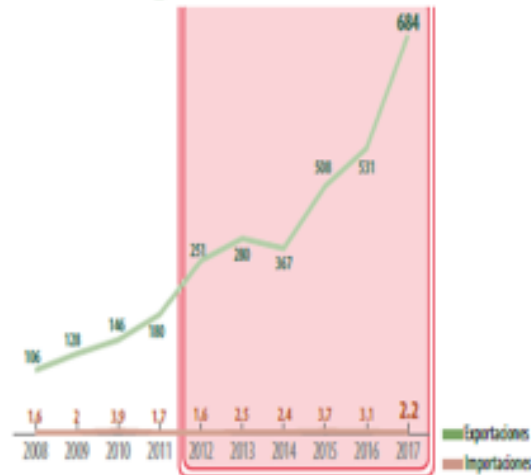
World ranking



Volume of national production 2012-2017 (thousands of tons)



Evolution of foreign trade (millions of dollars)



Mexico: Potential volume to irradiate

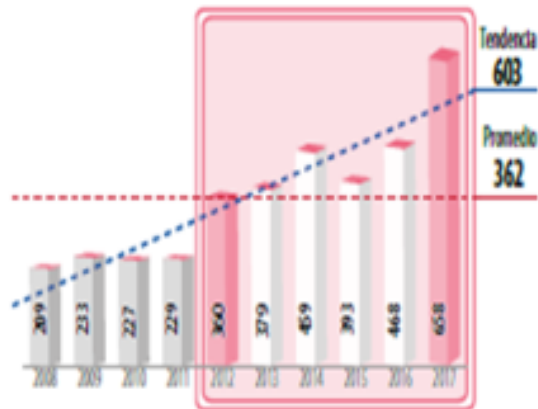


Strawberries

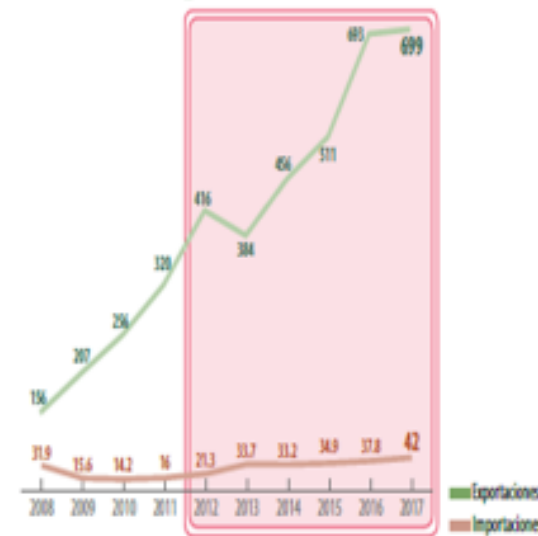
World ranking



Volume of national production 2012-2017 (thousands of tons)



Evolution of foreign trade (millions of dollars)



Source: eFoods Imports & e-AGRO Industrial

Mexico - Potential Market

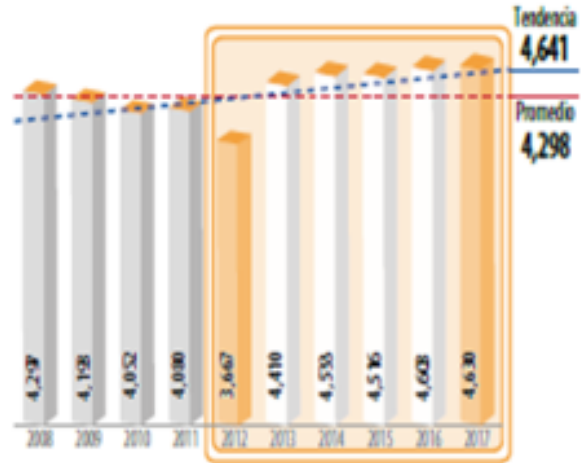


Orange

World ranking



Volume of national production 2012-2017 (thousands of tons)



Evolution of foreign trade (millions of dollars)



Mexico: Potential volume to irradiate

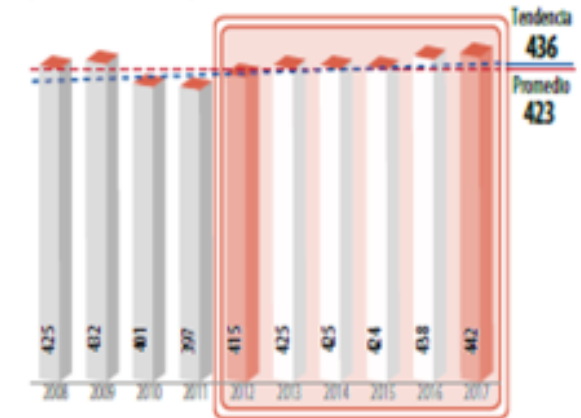


Grapefruit

World ranking



Volumen de la producción nacional 2012-2017 (miles de toneladas)



Evolution of foreign trade (millions of dollars)



Source: eFoods Imports & e-AGRO Industrial

Mexico - Potential Market

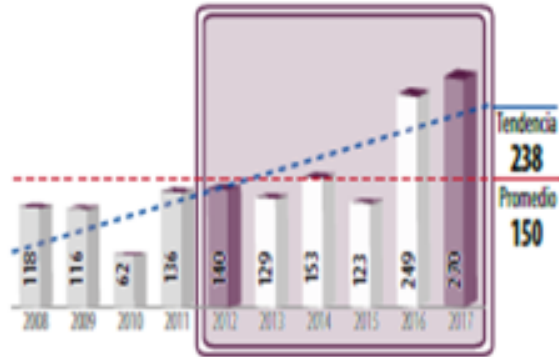


Blackberries

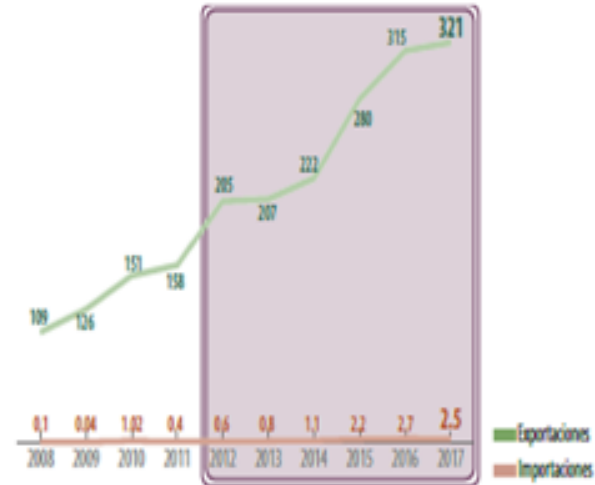
World ranking



Volume of national production 2012-2017 (thousands of tons)



Evolution of foreign trade (millions of dollars)

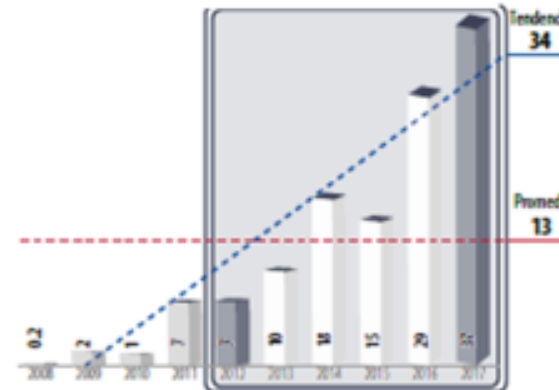


Blueberries

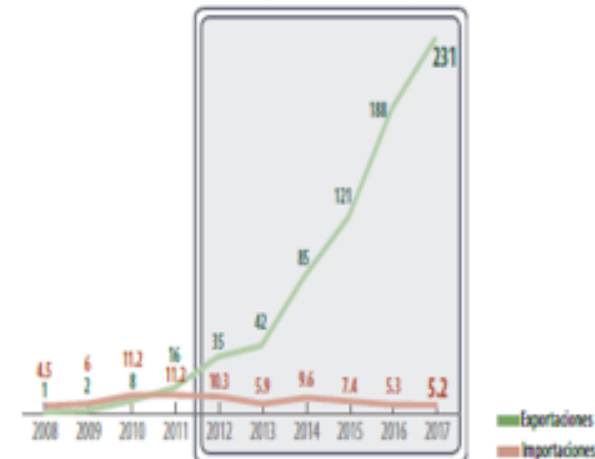
World ranking



Volume of national production 2012-2017 (thousands of tons)



Evolution of foreign trade (millions of dollars)



Mexico: Potential volume to irradiate



Source: eFoods Imports & e-AGRO Industrial

Mexico – Seasonality of Technology Need



EXPORTACIONES TOTALES POR MES 2008 AL 2020 (TONELADAS)

	ENERO	FEBRERO	MARZO	ABRIL	MAYO	JUNIO	JULIO	AGOSTO	SEPTIEMBRE	OCTUBRE	NOVIEMBRE	DICIEMBRE	TOTAL
2008	-	-	-	-	-	-	-	-	-	-	50	215	265
2009	70	67	73	58	186	97	94	171	363	547	828	1,011	3,565
2010	285	185	647	302	244	294	213	259	542	684	805	1,195	5,655
2011	382	324	489	297	331	406	295	258	439	352	689	1,102	5,364
2012	345	495	611	903	691	930	320	322	432	648	1,272	1,209	8,178
2013	802	627	744	751	662	586	621	428	702	793	1,098	1,426	9,240
2014	716	669	692	823	863	597	627	506	704	999	1,228	1,607	10,031
2015	798	729	708	965	952	889	859	667	757	943	1,536	1,909	11,712
2016	1,028	881	1,291	1,285	1,409	1,193	1,064	925	788	1,239	1,727	2,093	14,923
2017	1,156	1,356	1,504	1,661	1,616	1,713	1,222	954	1,145	1,167	1,748	1,974	17,216
2018	1,276	1,233	1,291	1,391	1,837	1,432	1,081	1,295	1,514	1,352	1,504	1,980	17,186
2019	1,597	2,050	2,146	1,977	2,114	1,615	1,436	1,176	1,508	1,254	1,720	2,194	20,787
2020	1,899	2,219	2,095	1,495	3,203	1,876	1,570	2,368	2,151	2,666	2,319	3,139	27,000
TOTALES	10,354	10,835	12,291	11,908	14,108	11,628	9,402	9,329	11,045	12,644	16,524	21,055	151.12

*Datos al 31 de diciembre del 2020

Source: ASEFIMEX, eFoods Imports & e-AGRO Industrial



Potential Volumes (tons) of Mexican Produce to Enter the US

Commodity	Production	Volume currently entering US by Ionizing Technology
Mango	1,541,890	~ 10,000
Guava	302,718	~ 19,500
Chile Manzano	2650	~ 1000



Mexico- Fresh Produce Treatment Options for Exports to the US

Commodity	Ionizing Technol	Cold Treatment	Methyl Bromide	High Temp. Forced Air	Vapor Heat	Hot Water Dip
Apple		X				
Carambola	150Gy					
Cherry		X				
Grapefruit & Dragonfruit	150Gy	X	X	X	X	
Guava	400Gy					
Mango	150Gy			X	X	X
Nectarine		X				
Sweet Lime	150Gy					
Sweet orange	150Gy	X	X	X	X	
Peach		X				
Manzano Pepper	150Gy					
Pomegranate	150 Gy					
Plum		X				
Tangerine/Clementine/Mandarin	150Gy	X		X		



Untapped Opportunities



Mexico

- 9th largest food processing country in the World
- 2nd largest food processing country in LATAM after Brazil
- Mexican food Industry ~ US \$ 770m in 2021 (~ 17.7% growth)
- Average Mexican household spends ~ 35% of income on food
 - US – 12%
 - India – 30%
 - Spain – 20%
- Mexico is a price-sensitive market but similar to US trends in terms of transparency/health & wellness/sustainability



Mexico- Markets Beyond Phytosanitary Treatment



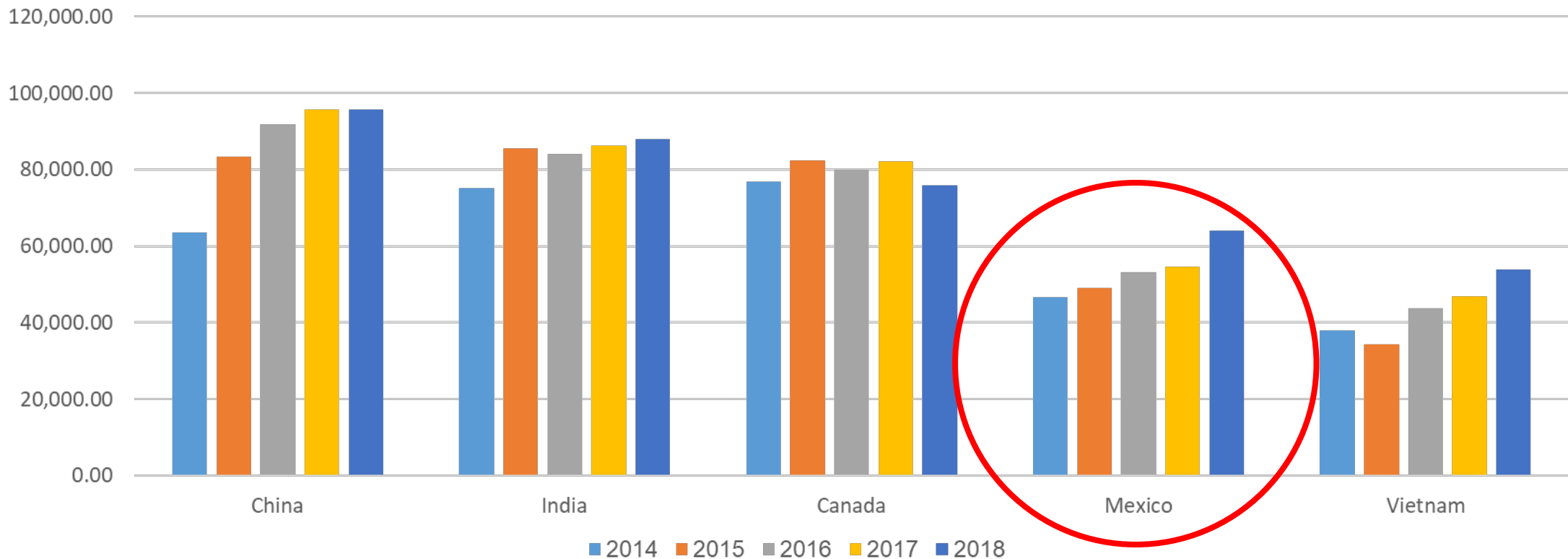
- Mexico is a price-sensitive market but similar to US trends in terms of transparency/health & wellness/sustainability
- Two big Mexican consumer segments
 - **High -end consumers** : high and middle socioeconomic levels demanding quality and functional products (normally imported)
 - **Regular consumers** : middle to low socioeconomic levels focused on price

Source: USDA, 2020



Mexico- Markets Beyond Phytosanitary Treatment

Volume (metric tons) of Imported Spices by Country of Origin



Source: USDA, 2019



Mexico- Ionizing Technology Growth Opportunity

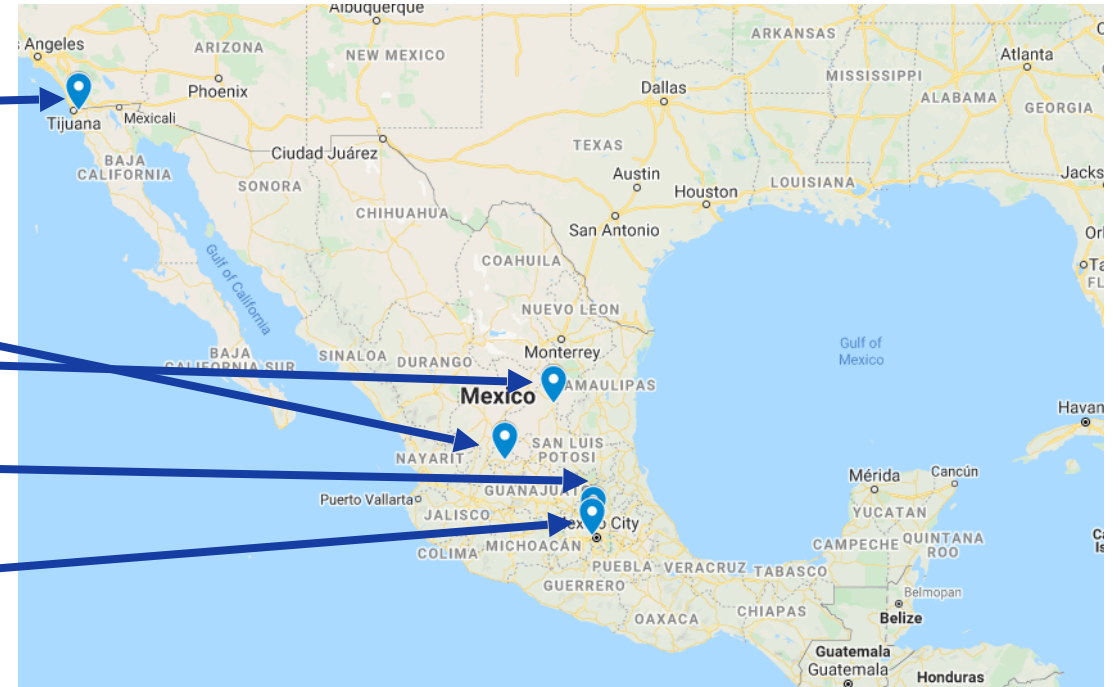
1. Avantti MediClear (**eBeam**) -
Tijuana

2. E-AGRO Industrial – (**Ebeam/X-ray**)- Aguascalientes

3. Benebion - (Cobalt-60) –
Matehuala, San Luis Potosi

4. Sterigenics – (Cobalt 60) -Hidalgo

5. ININ – (Cobalt-60) - Toluca

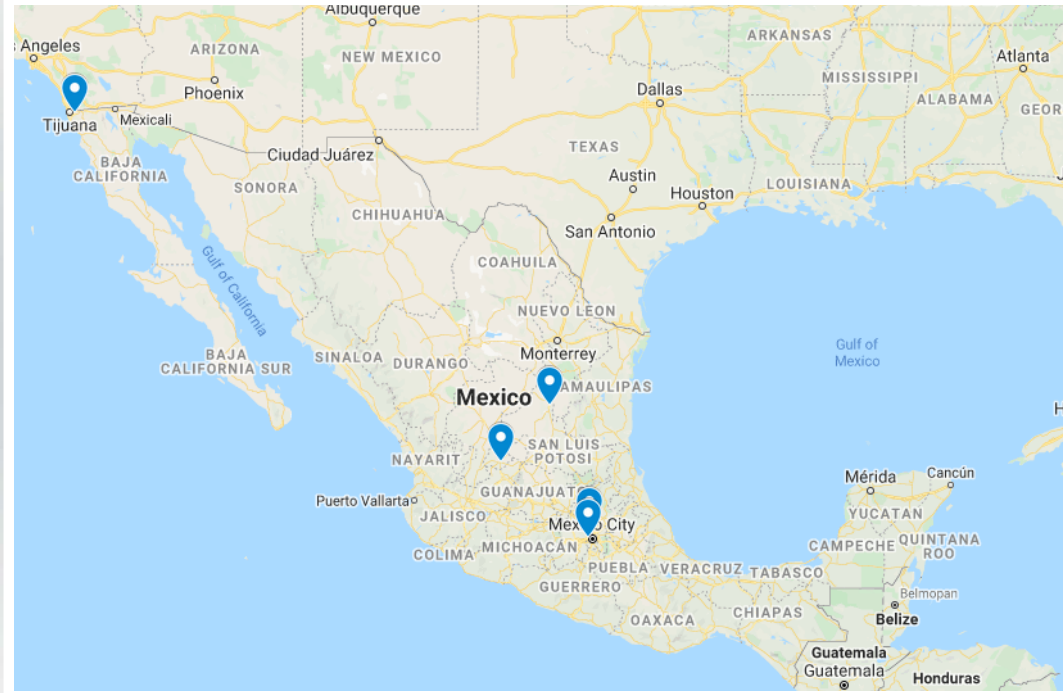




Mexico- Ionizing Technology Growth Opportunity

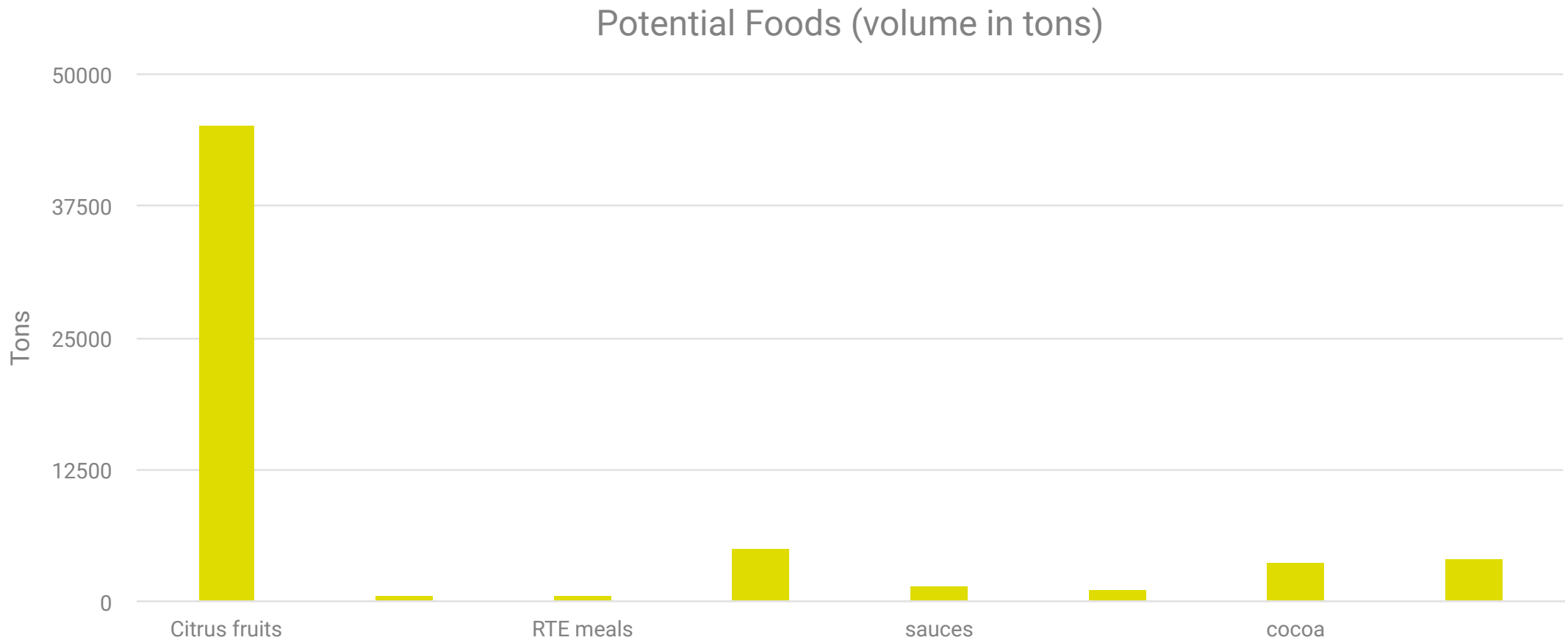


Food Processing Industries





Uruguay – Market Opportunity



Source: Anibal Abreu, 2019



Peru – Domestic Food Industry

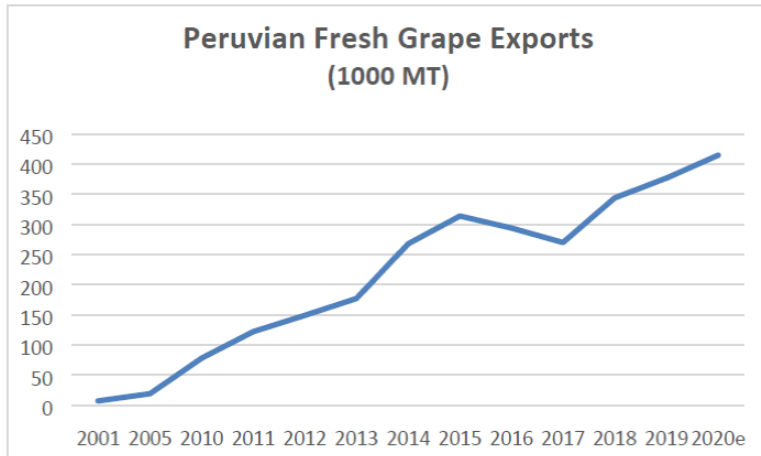
- Peru's food processing industry is dynamic sector of the national economy
- Food industry accounts for 22% of Peru's GDP
 - Food exports: \$ 8 billion
 - Food imports: \$ 5.7 billion
 - Domestic market: \$ 17.5 billion
 - Retail: \$ 4.4 billion
- Food processing industry sources both domestic and imported ingredients
 - Local processed foods account for 70% of market demand
 - 2/3 of US agricultural exports to Peru enter duty-free
 - US accounts for 30% of Peru's agricultural imports

Source: USDA, 2018

© Suresh Pillai, 2021



Peru – Market Opportunities



Source: USDA, 2018

Top 10 Growth Products in Peru

1. Live plants	7. Raisins
2. Fats and oils	8. Cranberries prepared
3. Prepared poultry meat	9. Cocoa powder
4. Whey	10. Mixture of spices
5. Pork meat	
6. Powder milk	

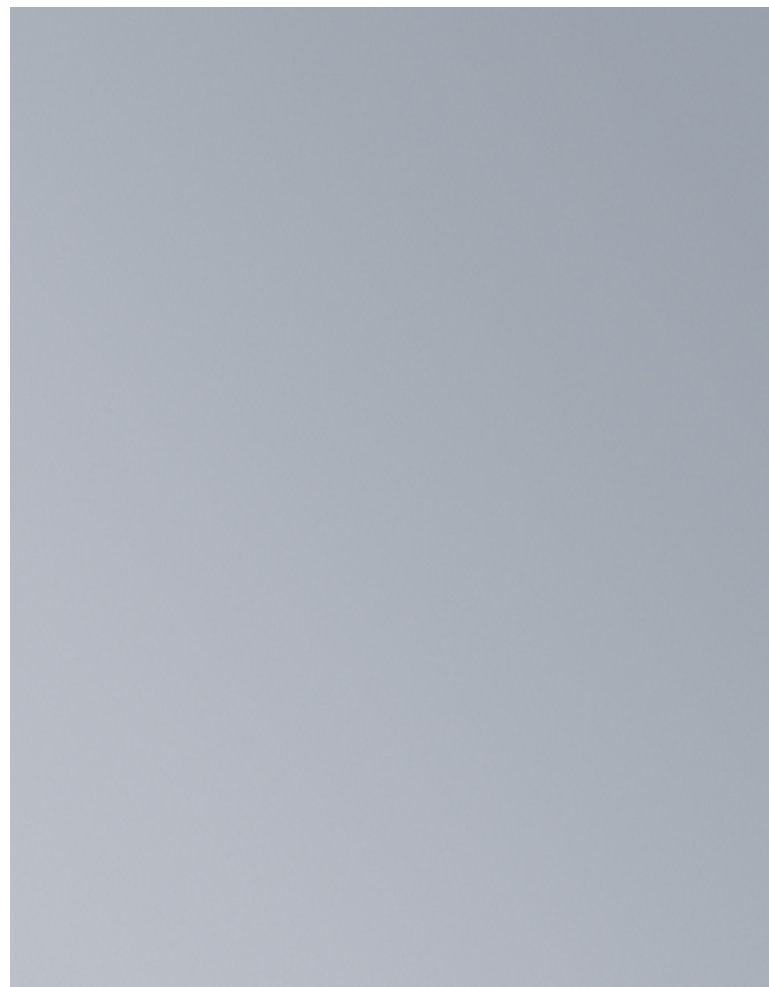
Source: USDA, 2018

3 Main Supermarket Chains in Peru

1. Cencosud
2. Saga Fallabella
3. Supermercados Peruanos

Opportunities

1. Strong demand for consumer food products
2. Growing middle class
3. Untapped category of frozen/refrigerated products





Argentina – Market Opportunity

- # 7 food producer in the world
- # 11 in world food exports
- \$ 26 billion – food processing industry value
 - Meat: 7%
- \$8.5 billion – value of ingredients used by food industry
 - \$100 million – food ingredient market
- ~ 21,500 food processors



Source: USDA, 2020/Secretaría de Gobierno de Agroindustria en base a datos del INDEC, la FAO y estimaciones propias
Abril Drach, 2019:



Argentina – Market Opportunity

d) Control cuarentenario.	CEREALS and their FLOURS, LEGUMES, OILSEEDS, DRIED FRUITS	1,0
CLASE 3 – CEREALES Y SUS HARINAS, LEGUMBRES, SEMILLAS OLEAGINOSAS, FRUTAS SECAS		
Propósitos:		
a) Desinfestación de insectos.		1,0
b) Control de microorganismos alterantes y patógenos.		5,0
CLASE 4 – VEGETALES Y FRUTAS DESECADOS O DESHIDRATADOS, CONDIMENTOS VEGETALES(*), TE Y HIERBAS PARA INFUSIONES		
Propósitos: DRIED VEGETABLES AND FRUITS, SPICE, TEA and HERBS FOR INFUSIONS		
a) Control de microorganismos patógenos.		10
b) Desinfestación de insectos.		1,0
CLASE 5 – HONGOS DE CULTIVO COMESTIBLES, FRESCOS		
Propósitos: FRESH EDIBLE MUSHROOMS		
a) Control de microorganismos alterantes.		3,0

2019

CLASE 6 – PESCADOS Y MARISCOS, Y SUS PRODUCTOS (FRESCOS Y CONGELADOS)		
Propósitos: FISH and SEAFOOD and their products (Fresh and frozen)		
a) Control de microorganismos alterantes y patógenos.		5,0 (**)
b) Control de parásitos.		2,0 (***)
CLASE 7 – AVES, CARNES BOVINA, PORCINA, CAPRINA, OTROS Y SUS PRODUCTOS (FRESCOS Y CONGELADOS)		
Propósitos: Birds, bovine's, pig's and goat's meats and their products (fresh and frozen)		
a) Control de microorganismos alterantes y patógenos.		7,0 (**)
b) Control de parásitos.		3,0 (***)
CLASE 8 – ALIMENTOS DE ORIGEN ANIMAL DESECADOS		
Propósitos: Dried animal food		
a) Control de insectos.		1,0
b) Control de hongos.		3,0

Source: Abril Drach, 2019



Argentina –Market Opportunity



International Food and Agribusiness Management Review
Volume 19 Issue 2, 2016

Food Security in Argentina: A Production or Distribution Problem?

Roberto Feeney^a and Pablo MacClay^b

^a Associate Professor, Center for Food and Agribusiness, Austral University, 1950 Paraguay Street,
Rosario City, Argentina

^b Assistant Professor, Center for Food and Agribusiness, Austral University, 1950 Paraguay Street,
Rosario City, Argentina

- Argentina produces enough food to serve its internal and export needs
- There is substantial opportunity to increase the consumption of fruits and vegetables
- **Incentives to food processing industry for improving quality, safety and packaging can have significant upside**



Brazil – Market Opportunity

- 5th largest packaged food market in the world
- Packaged food industry is very well developed
- Food Processing Industry : \$ 179 million
- Major Global player in food processing
- **Imported \$2.8 billion of intermediate food products**
 - **EU – 31%**
 - **Mercosul – 27% (Uruguay is a major exporter to Brazil)**
- **Domestic Market : \$ 143.7 Billion**
 - **Retail : \$ 97 Billion**
- **Major Retailers**
 - Carrefour
 - Grupo Pao de Acucar
 - Walmart Brasil



Brazil – Market Opportunity

- Unconditional Approval for Ionizing Technology
 - Strawberries
 - Potatoes
 - Onions
 - Garlic
 - Poultry
 - Papaya
 - Flour
 - Fish
 - Rice
 - Spices
 - Beans
 - Corn

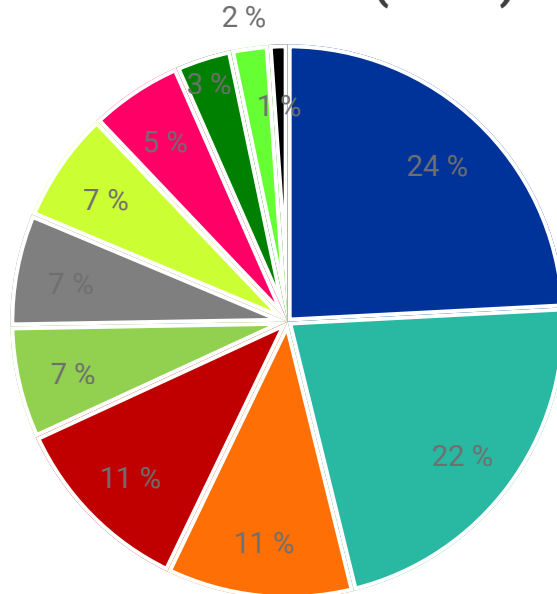


Source: Pablo Vasquez, 2019

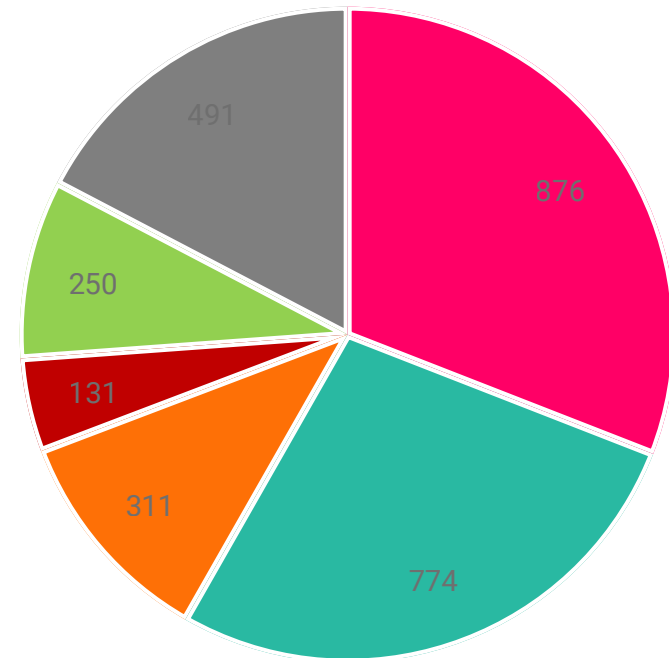


Brazil – Market Opportunity

% Gross Sales (2018)



Import Value (\$ Million)



- Meat products
- Cereals
- Snacks
- Confectionary
- Beverages
- Wheat products
- Sugar refining
- Fish
- Dairy Products
- Fruits and Vegetables
- Dehydrated/frozen
- European Union
- MERCOSUL
- United States
- China
- Indonesia
- Others



Potential vs Reality

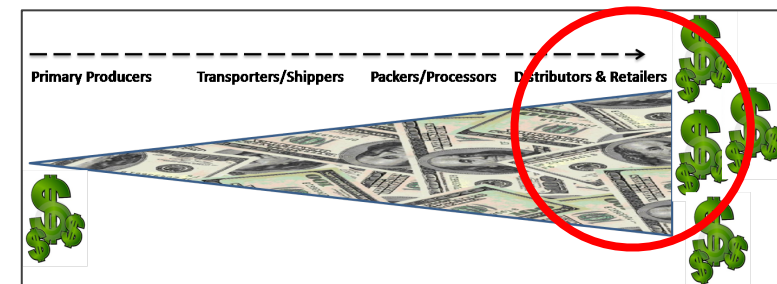
- Retailers have the ultimate say in whether a particular technology is adopted
- **Retailer outreach and education will have the highest ROI**

Important question

- **Is the technology widely available today for widescale adoption?**

Important Needs

- Private investment into eBeam and X-ray technologies for food industry
 - 3rd party service facilities or Design-Build-Operate (DBO) businesses
- Harmonization of regulations in the Americas





Food Industry Needs and Ionizing Technology Capacity

- Food industry will be unable to command base-loading contract rates with 3rd party commercial sterilizers because volumes and doses significantly lower than medical device industry
 1. In-house capability for small to medium volumes
 2. Access to 3rd party commercial service provider
- Highly Segmented Dose Requirements
 - Food Pasteurization
 - E.g., ground beef (min doses ~ 1.8 kGy)
 - Fruit Disinfestation
 - E.g., mango disinfestation (min doses ~ 400 Gy)
 - Spice and Food Ingredient Treatment
 - Ground pepper and spice blends (doses < 15 kGy)



Technologies to Accelerate Adoption



External 3rd party service provider



In-line/ end-of-line/in-house service

Food industry



Laatu™
Buhlergroup.com



ITHPP-ALCEN



PCT Ebeam Xbeam System
> 100 kg/hr



Low Energy
Electron Beam &
Low Energy X-ray

Power (kW)

160
120
80
40

LEEB
LEEX
Low Energy
(80 keV - 300 keV)



Medium Energy
Electron Beam &
Medium Energy X-ray

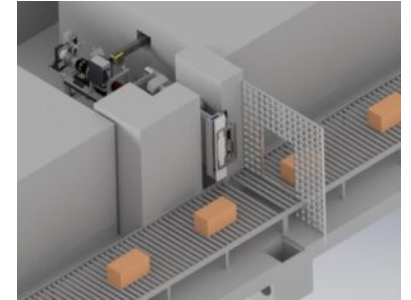
MEEB
MEEEX
Medium Energy
(1 MeV - 3 MeV)



High Energy
Electron Beam &
High Energy X-ray

HEEB
HEEX
High Energy
(3 MeV - 10 MeV)

Energy (MeV)





Suresh D. Pillai

s-pillai@tamu.edu

979. 458. 3229

<http://ebeam-tamu.org>

