

Recent Advances in Food Technology

Ranjan Sharma PhD MBA

Presentation Summary

- ▶ Recent advances in food technology
 - Advances in food products
 - Functional foods
 - Advances in food processing
 - Alternative technologies to heat pasteurisation
 - Pulse Electric Fields
 - Ohmic heating
 - Microwave processing
 - Microfiltration
 - UV Illumination
 - Irradiation
 - High Pressure Processing
- ▶ Conclusions

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History of pasteurisation

- ▶ *Pasteurization* was named after the famous French scientist Louis Pasteur who discovered in 1864 that spoilage organisms could be inactivated in beer and wine by applying heat at temperatures below its boiling point. The process was later applied to milk.
- ▶ Since then nothing has really been seen as a viable alternative to heat pasteurisation by the food industry....until recently....



Alternatives to heat pasteurisation – why?

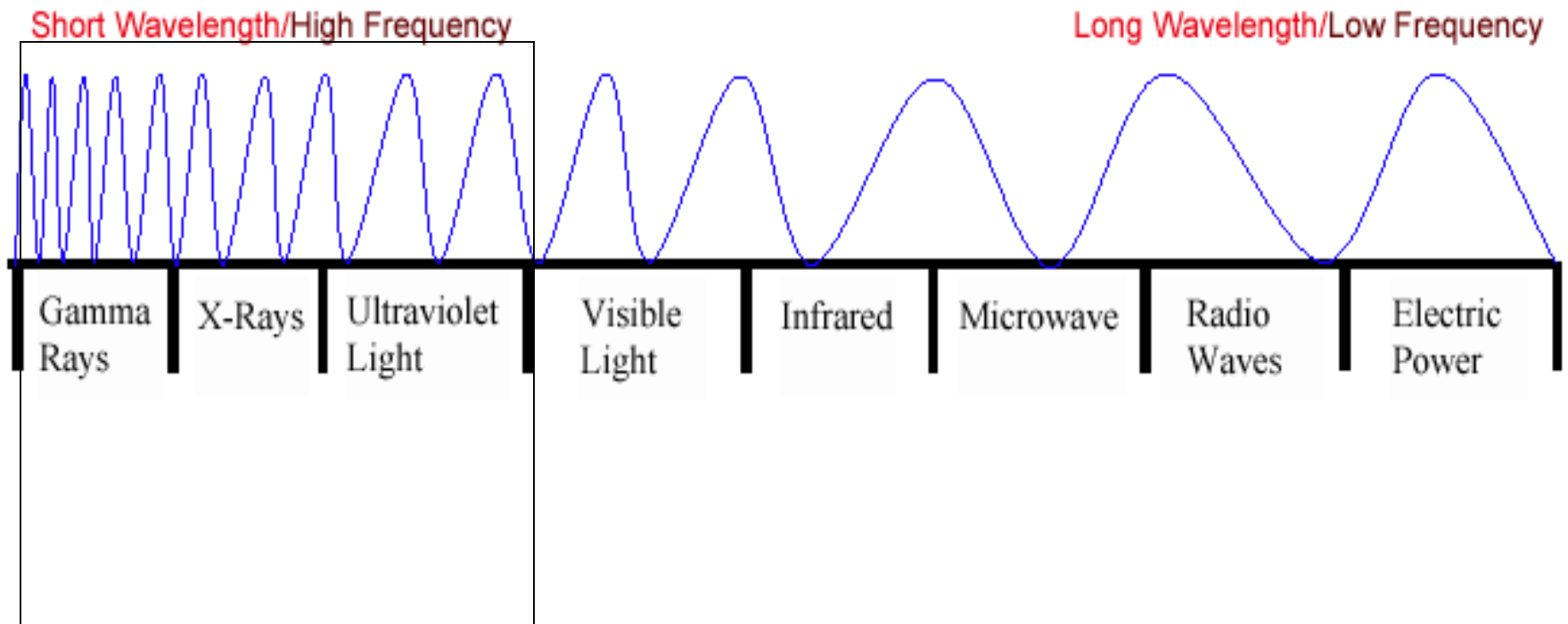
- ▶ Flavour and taste
- ▶ Nutritional quality
- ▶ Food safety concerns for certain products – meat, grains/seeds, fresh fruits and vegetables
- ▶ Advances in non-thermal processing technologies for food

Irradiation

Radiation

- ▶ Energy waves produced by different sources
- ▶ Ionising radiation – high frequency & high energy producing charged ions by knocking of electrons in a molecule
 - Gamma ray, X– ray and UV radiation
- ▶ Non–ionising radiation – does not produce ions but can create heat under moist conditions
 - Microwave

Ionising radiations



Irradiation

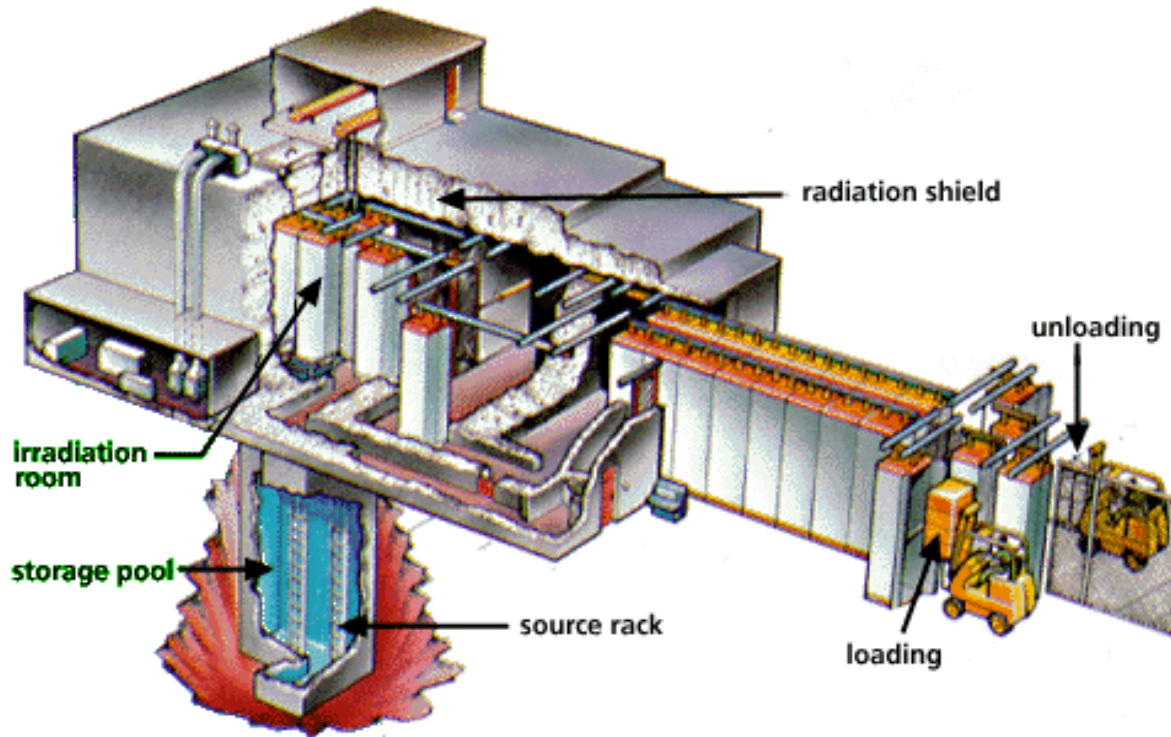
- ▶ Irradiation can kill harmful bacteria and other organisms in meat, poultry, and seafood, disinfect spices, extend shelf-life of fresh fruits and vegetables, and control sprouting of tubers and bulbs such as potatoes and onions.
- ▶ Considered safe & approved by the U.S. FDA and over 50 (including Australia) other national food control authorities for many types of foods.
- ▶ Accepted sources of radiation in Australia
 - Cobalt-60 sourced gamma rays, machine generated X-rays, or an electrically generated electron beam (E-beam)
- ▶ Joint FAO/IAE Food Irradiation Clearance database
 - To check which products are approved in various countries (<http://nucleus.iaea.org/NUCLEUS/nucleus/apps/FICDB/DatabaseHome.html>)

Electron beam (E-beam) treatment



- ▶ [Video on e-beam \(7 min\)](#)

Co-60 Gamma radiation



Video – Co-60 gamma radiation (4 min)

USFDA – radiation dose limits

General recommendation – keep below 10 kGy

Food Type	Dose (kiloGrays)
fruit	1
poultry	3
spices, seasonings	30

http://www.epa.gov/radiation/sources/food_irrad.html

Effect on shelf life



Irradiated foods in Australia

- Food can only be irradiated if there is no other safe method available. Any irradiated food must go through a strict safety assessment by Food Standards Australia New Zealand and, if approved, must be labelled as having been treated by irradiation.
- Only herbs and spices and some tropical fruits have been approved to be irradiated.
 - A1038 – FSANZ application (2009) for approval of irradiation of persimmons by Queensland Department of Primary Industries and Fisheries (To provide permissions to irradiate persimmons (*Diospyros kaki*) as a quarantine measure)

Pulse electric field, PEF

Pulse Electric Field

Short (microsecond) high voltage (20–80 kV.cm) electric pulses, making microbial cell membranes permeable and cause cell death

Continuous process suitable for liquid food products (e.g. Juices, milk, yogurt, soups, and liquid eggs)

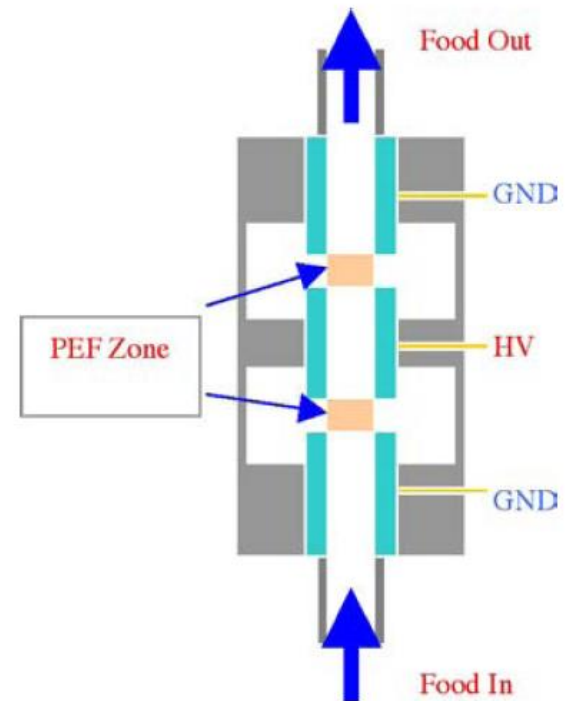
Better retention of flavour and colour than heat pasteurisation

5 log reduction similar to pasteurisation

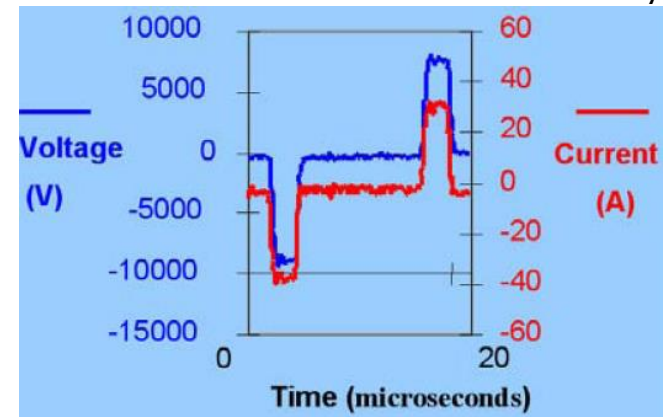
Limited effect on spore

Little effect on enzymes (pectinase, polyphenol oxidase)

Not suitable for foamed products & high electrical conductivity



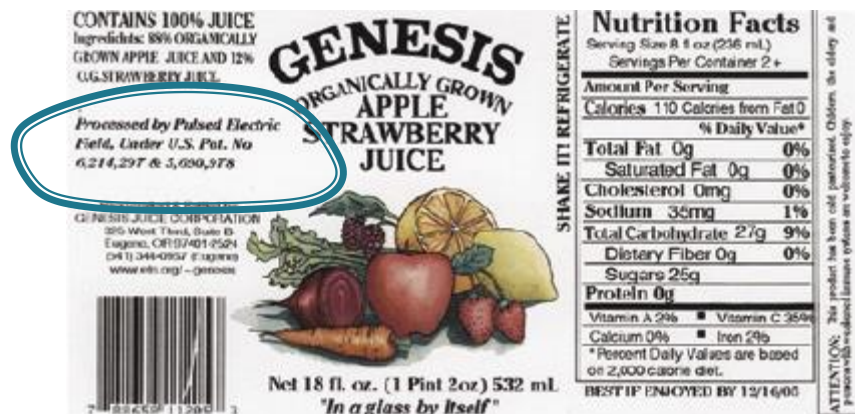
Ohio State University



Pulse Electric Field



- Genesis Juice Cooperative in the Portland, Oregon*
- *Licensed technology from Ohio State University*
 - *4 weeks chilled shelf-life*
 - *Fresh taste*
 - *closed its business in 2007 – Food safety issues*
 - *Brand purchased by Toby's Family Farm*
 - *No commercial product available now*



Nutrition Facts

Serving Size 8 fl oz (236 mL)
Servings Per Container 2+

Amount Per Serving
Calories 110 Calories from Fat 0

% Daily Value*

Total Fat 0g 0%

Saturated Fat 0g 0%

Cholesterol 0mg 0%

Sodium 35mg 1%

Total Carbohydrate 27g 9%

Dietary Fiber 0g 0%

Sugars 25g

Protein 0g

Vitamin A 25% Vitamin C 25%

Calcium 0% Iron 25%

*Percent Daily Values are based on 2,000 calorie diet.

BEST IF ENJOYED BY 12/16/05

ATTENTION: This product has been cold pasteurized. Children, the elderly and persons with weakened immune systems are vulnerable to injury.

Microfiltration

Microfiltration for ESL Milk

Raw milk



Microfiltration

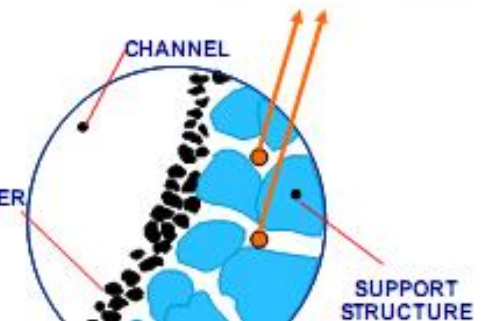
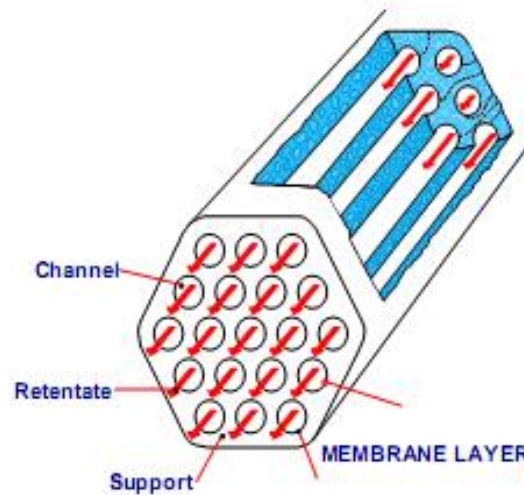


Pasteurisation

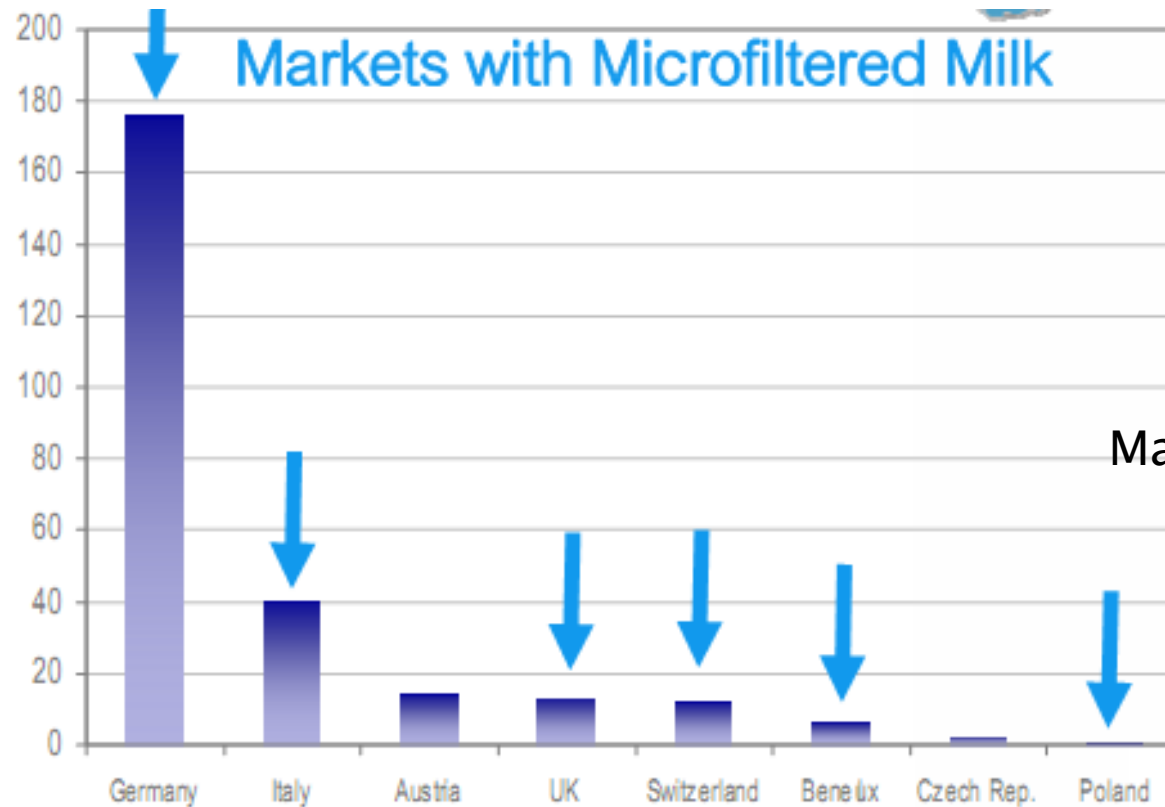


Packaging

Multichannel ceramic element

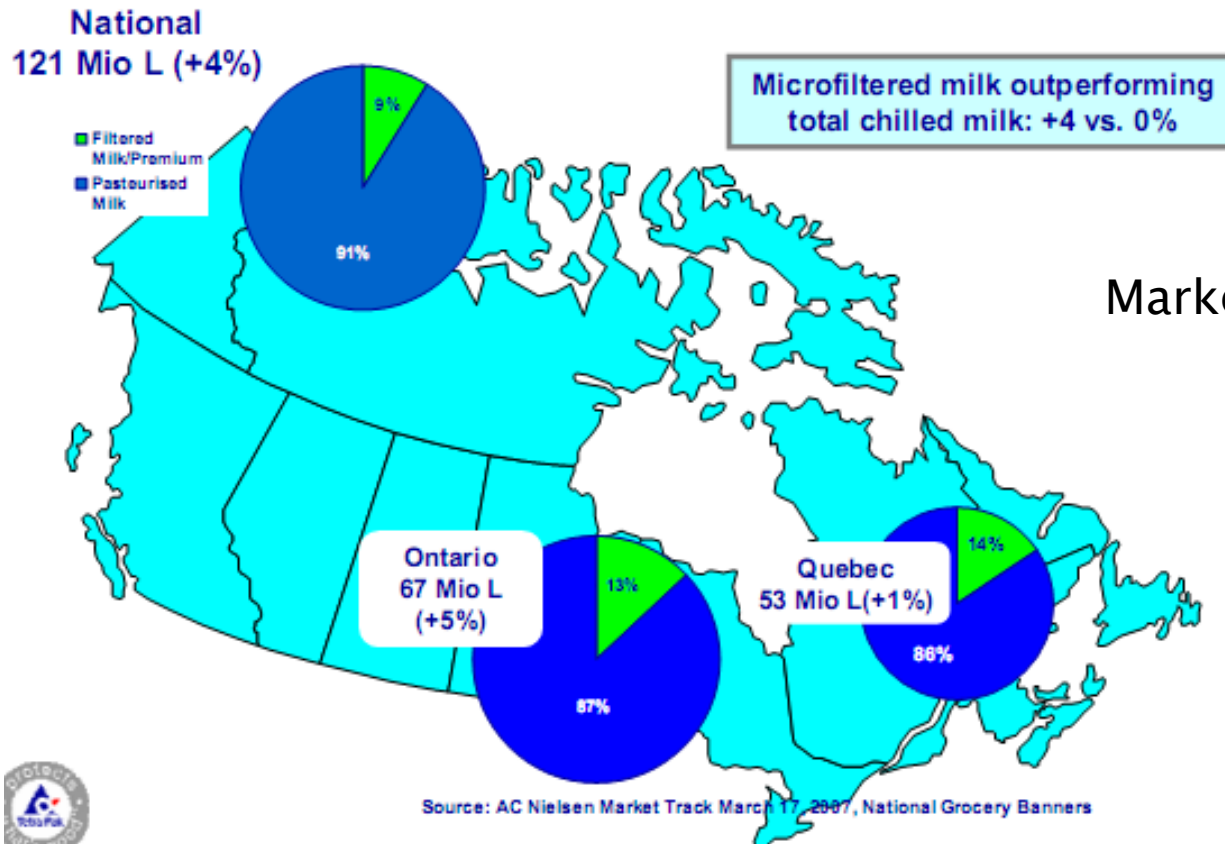


ESL – MF milk in EU



Tetrapak

ESL – MF milk in Canada, 2006



Market share – 10–12%



ESL aseptic dosing applications

Probiotic
beverages



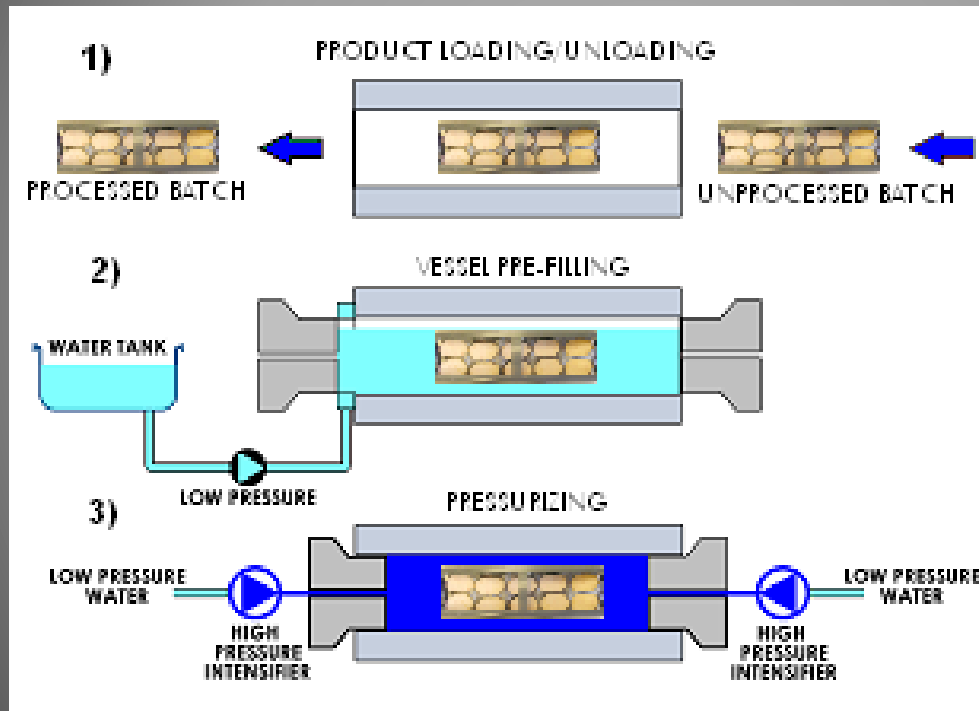
CHR HANSEN

- Live microbial food ingredient that have a beneficial effect on human health when consumed in adequate amounts
- Traditionally only available in yoghurt and fermented milk

High pressure processing

- ▶ Non-thermal processing
- ▶ First commercialised in Japan in the early 1990s for pasteurisation of acid foods for chilled storage
- ▶ High pressure treated foodstuffs have been marketed in Japan since 1990 and in Europe and the United States since 1996
- ▶ Slow commercialisation
 - High investment and slightly higher processing costs
 - Low throughput

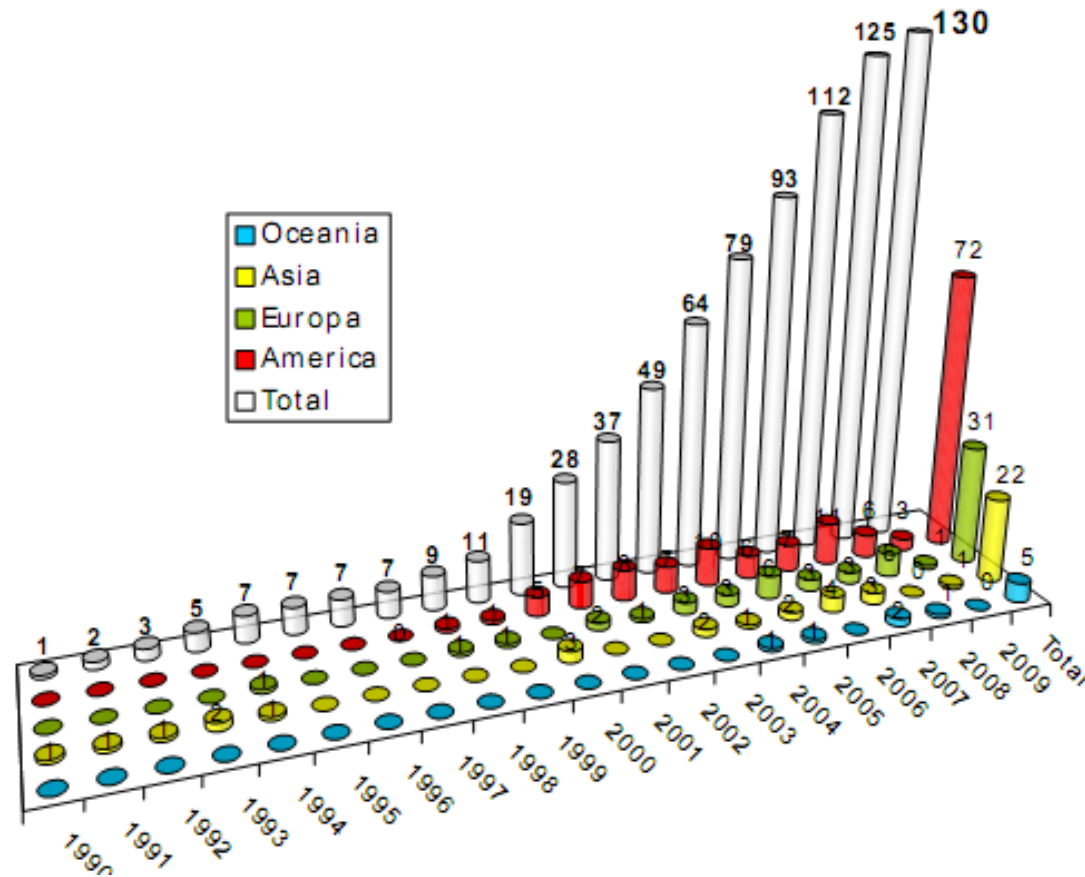
HPP process



HPP – Advantages

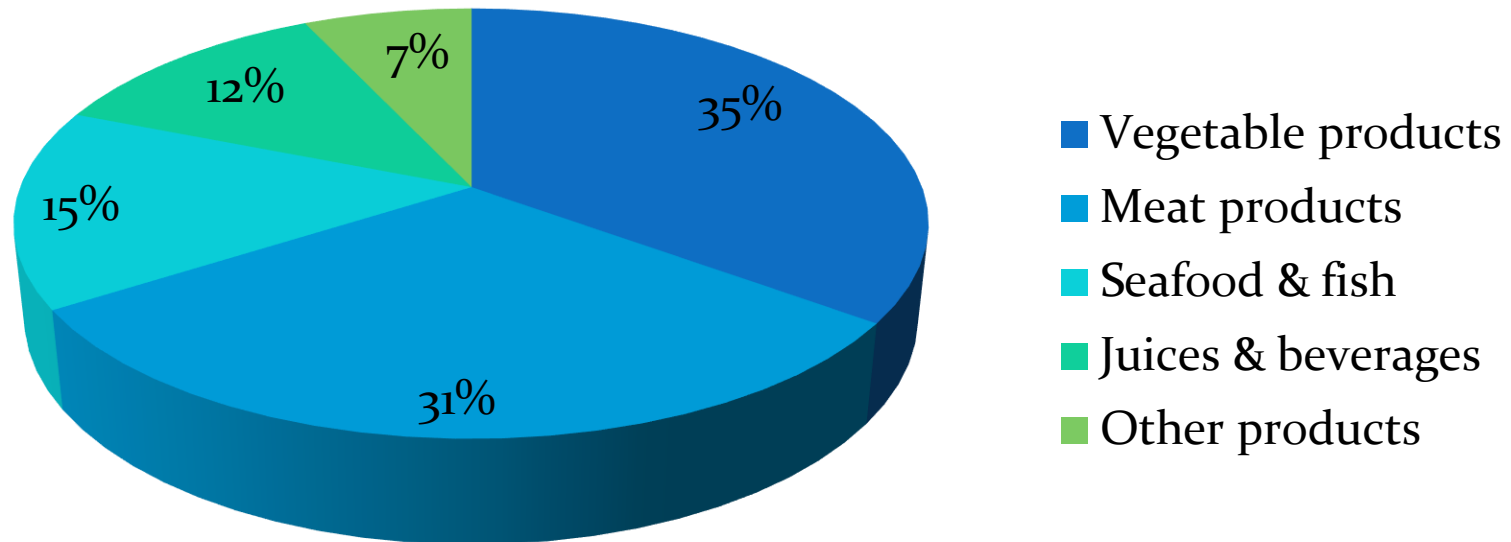
- ▶ Attractive for consumers – meets demand for freshness and minimal & additive-free processing
- ▶ No consumer negativity as associated with other food processing technologies (*e.g.* irradiation and GM)
- ▶ Extended shelf life enables wider product distribution and results in fewer product returns
- ▶ Less energy use(hence greenhouse gases) than other technologies and has the highest processing efficiency for pumpable foods
- ▶ Processing can be done in final packaging thus avoiding post-processing contamination and tempering
- ▶ Valuable low molecular constituents, such as vitamins, colours and flavourings remain largely unaffected

No. Of HPP machine installation around the world



HPP products availability

Product-wise HPP application

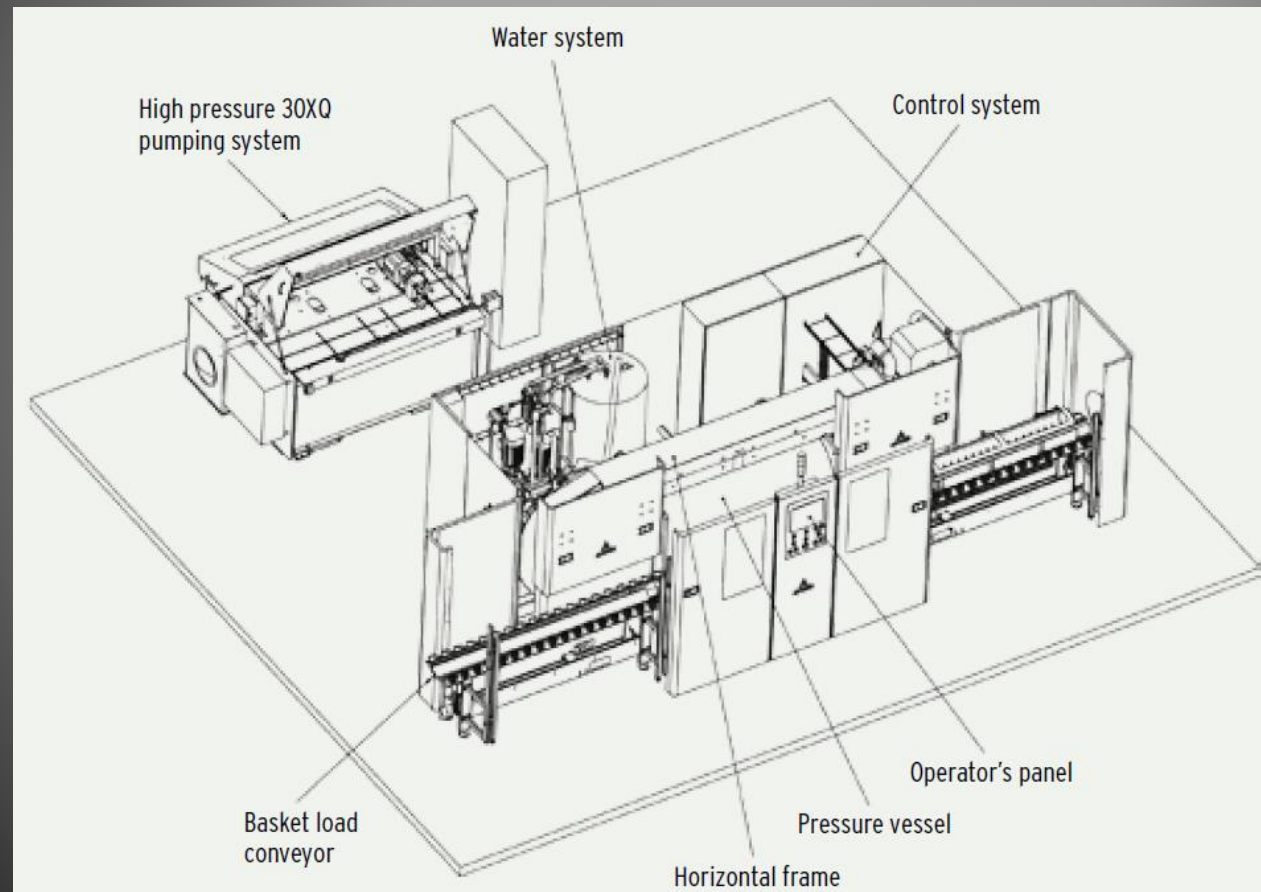


HPP Machine setup – 135 L



NC Hyperbaric

HPP – QFP 100L-600

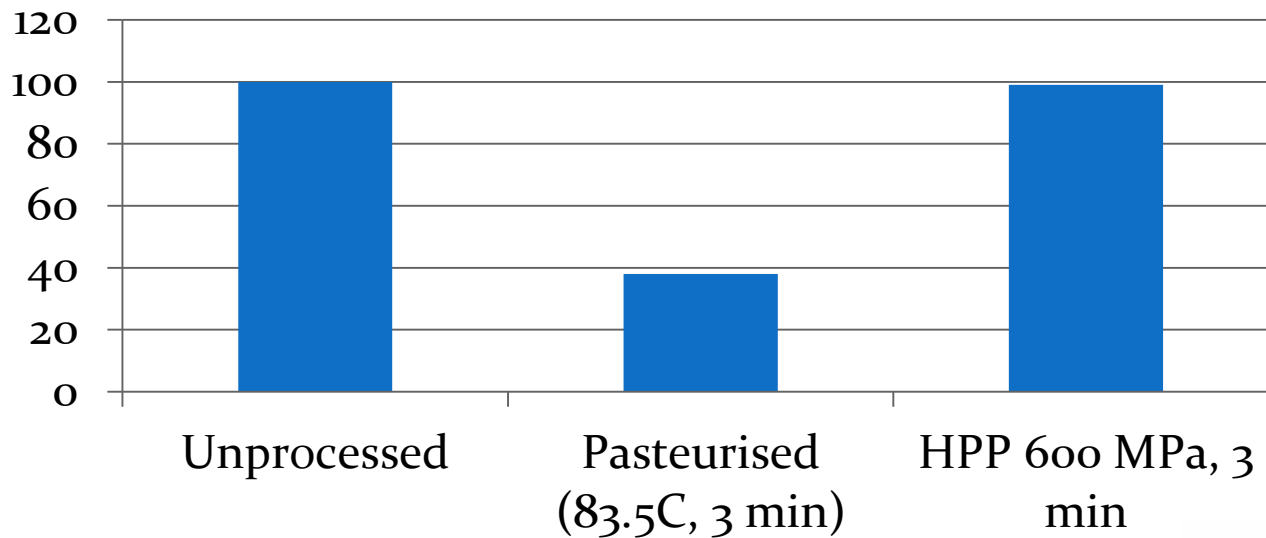


HPP product examples



HPP – immunoglobulins

Immunoglobulins (%)



Protecting your immunity,
the way Mother Nature intended...

Patent WO/2006/096074 (Fonterra)



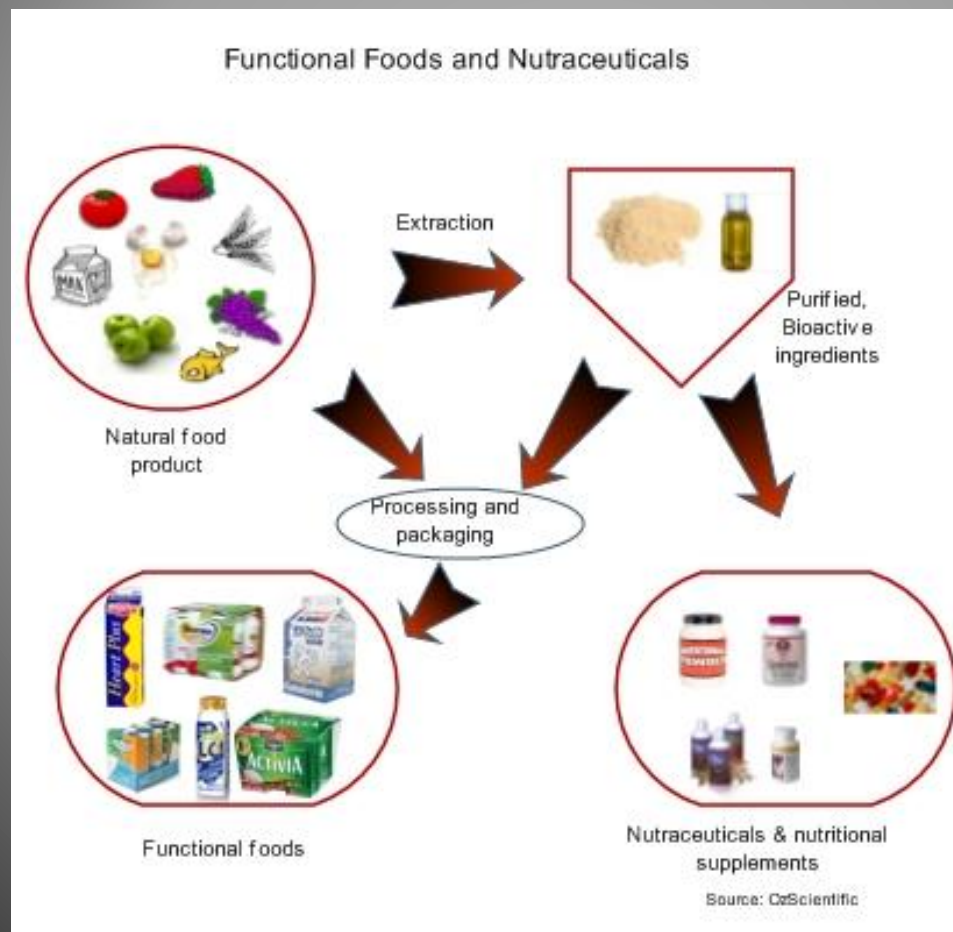
- ▶ HPP videos
 - Hormel natural Choice – 30 s
 - Mitsunori HPP – 6 min

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Product innovation trends

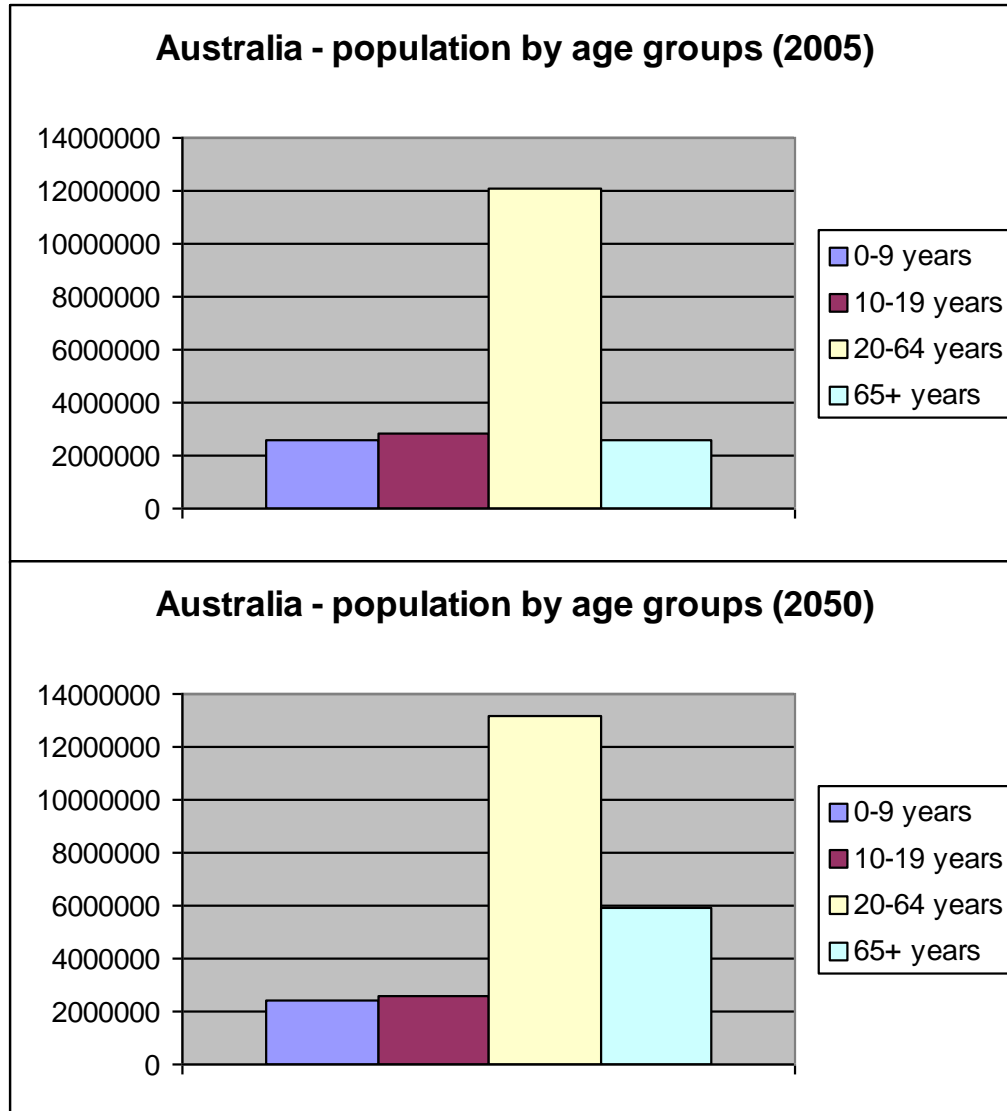
– functional foods



Drivers for functional food development

- ▶ Population demographics
- ▶ Rising obesity – the health condition/disease of the millennium
- ▶ Increased incidences of non-communicable, chronic diseases
- ▶ Growing proportion of unhealthy kids
- ▶ Consumer awareness of food–health relationships

Population trends – Australia



2005

2050

US Census Bureau

Life expectancy at birth

Major area	2000-2005	2045-2050
World	65.4	75.1
More developed regions	75.6	82.1
Less developed regions	63.4	74.0
Least developed countries	51.0	66.5
Other less developed countries	66.1	76.3
Africa	49.1	65.4
Asia	67.3	77.2
Europe	73.7	80.6
Latin America & Caribbean	71.5	79.5
North America	77.6	82.7
Oceania	74.0	81.2

UN(2005) World Population Prospects The 2004 Revision, UN, New York
<http://www.un.org/popin/data.html>

Drivers for consumer food product development

- ▶ Population demographics
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Adult overweight projection

Country	Sex	2005	2015
Australia	Females	62.7	70
Australia	Males	72.1	79
Canada	Females	57.1	61.9
Canada	Males	65.1	68.6
New Zealand	Females	68.2	79.2
New Zealand	Males	68.7	78.5
United Kingdom	Females	61.9	65.7
United Kingdom	Males	65.7	69.8
United States	Females	72.6	80.2
United States	Males	75.6	84.5

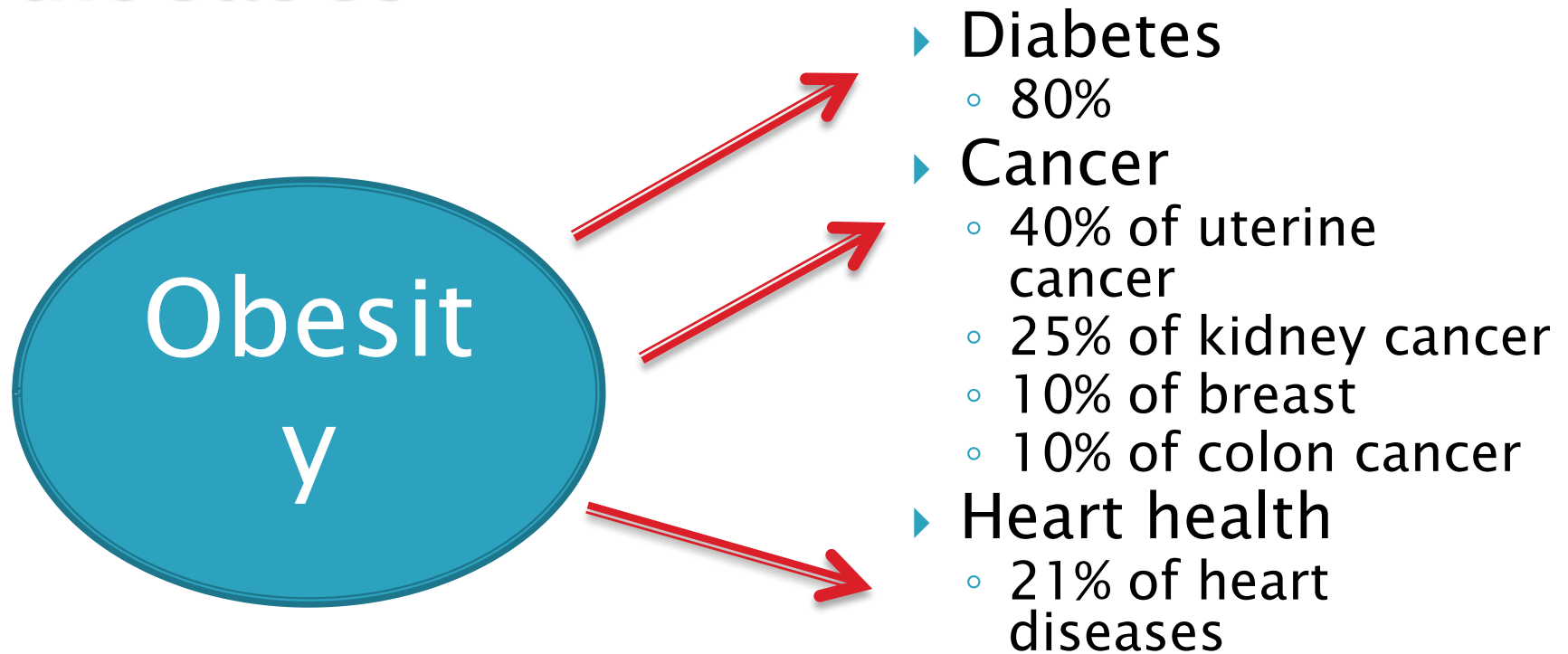


Adult obesity projection

Country	Sex	2005	2015
Australia	Females	24.9	33.5
Australia	Males	23.8	33.3
Canada	Females	23.2	28.2
Canada	Males	23.7	27.4
New Zealand	Females	31.5	48.1
New Zealand	Males	23	35.2
United Kingdom	Females	24.2	28.3
United Kingdom	Males	21.6	25.8
United States	Females	41.8	54.3
United States	Males	36.5	51.7



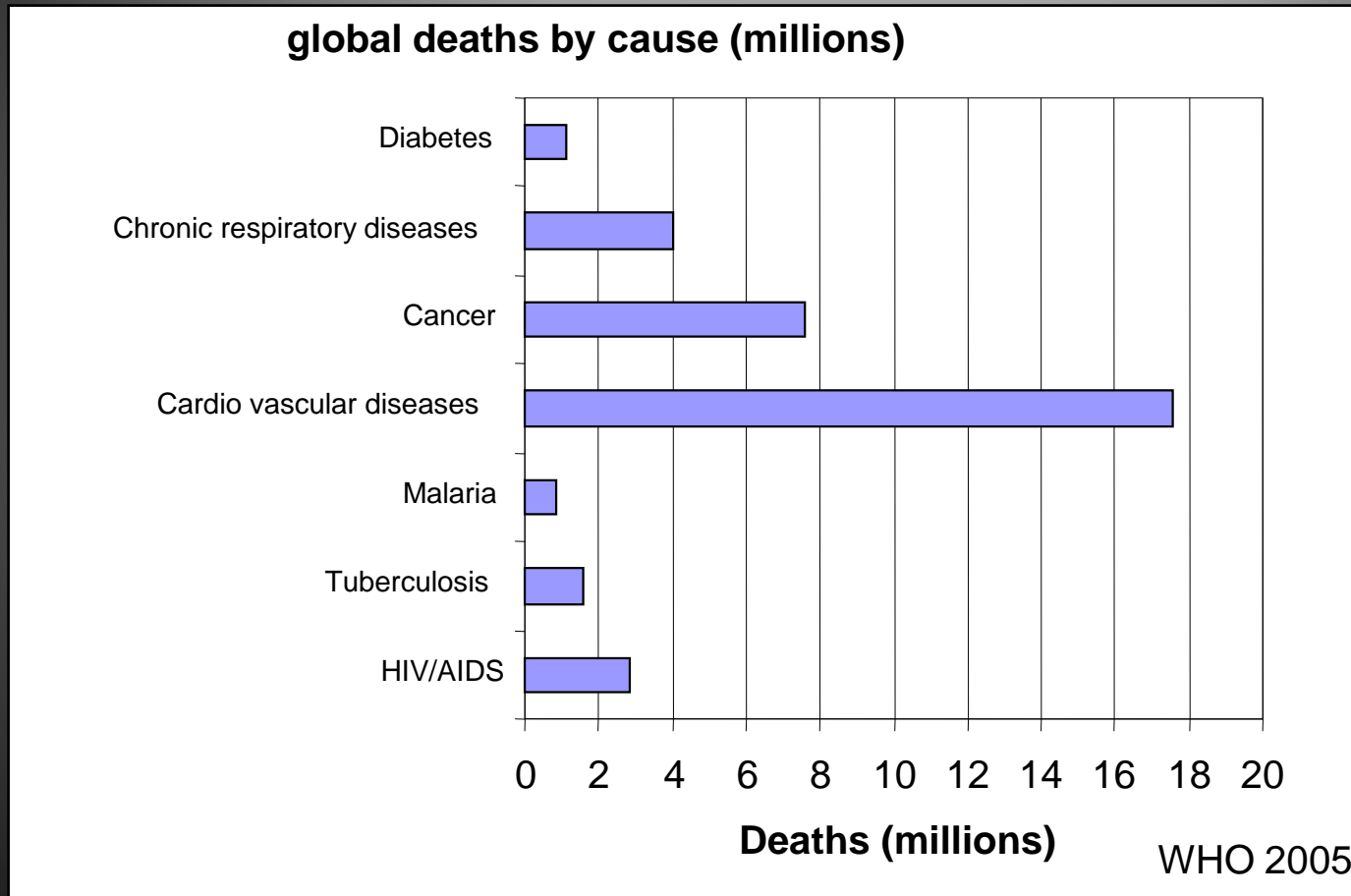
Obesity a major factor in lifestyle diseases



Drivers for consumer food product development

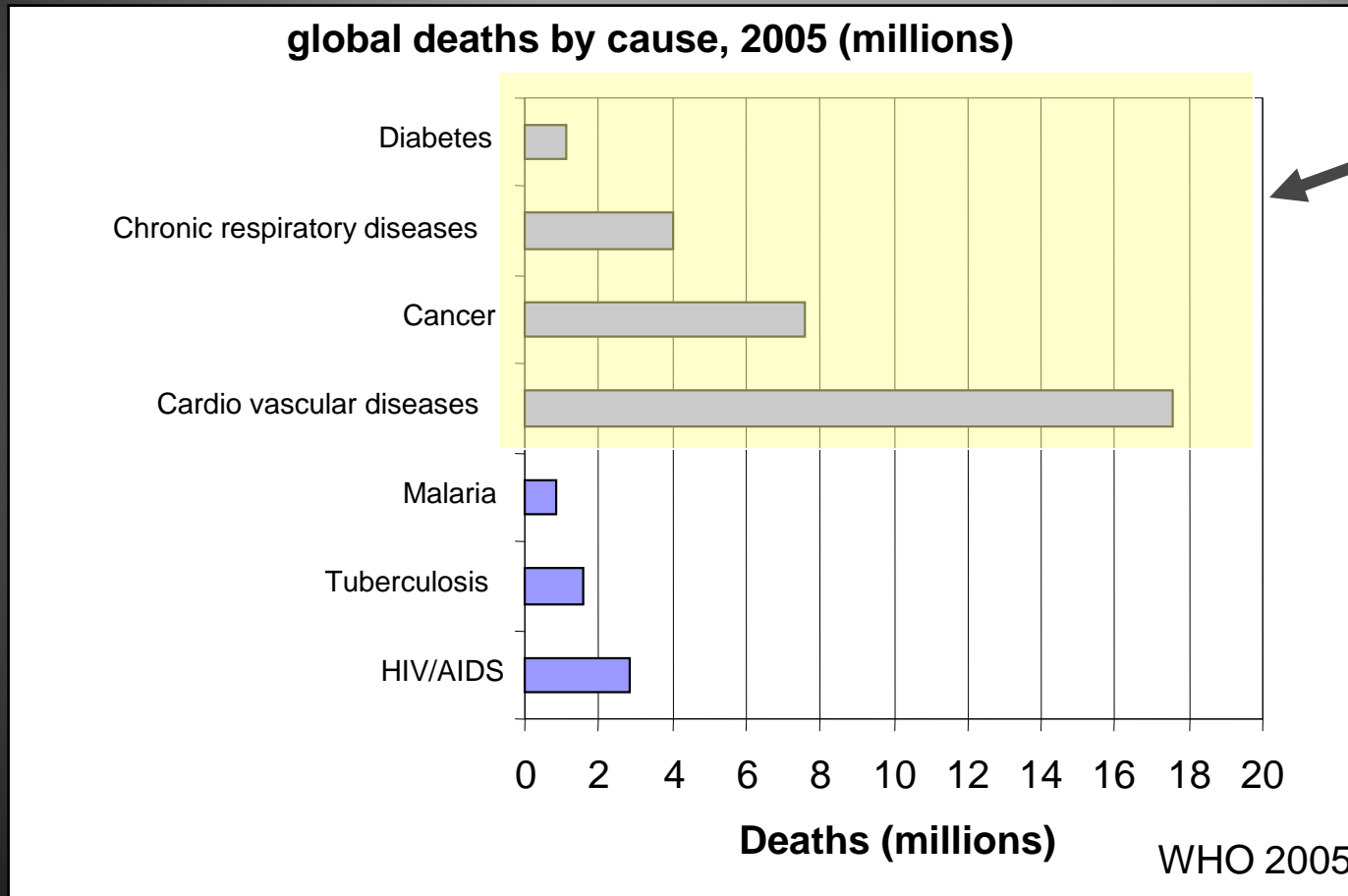
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Diseases causing global deaths



Total deaths – 58 million

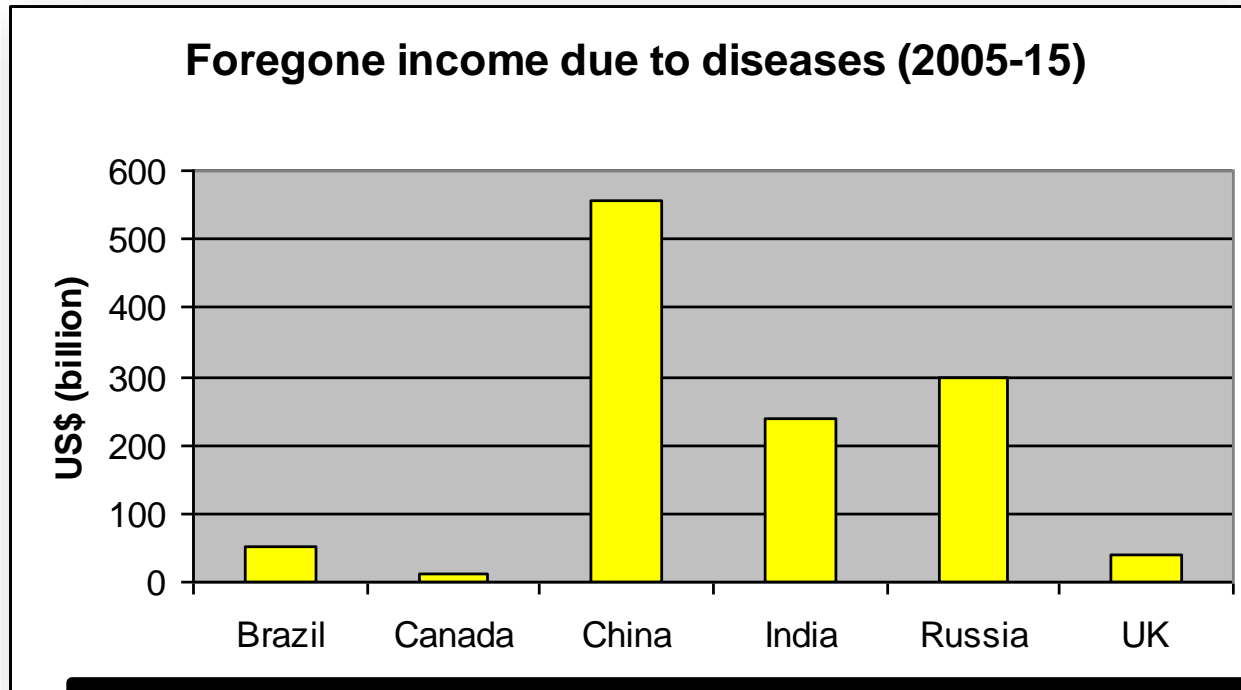
Diseases causing global deaths



Chronic diseases

Total deaths – 58 million

Foregone income to deaths by chronic diseases



US\$558 billion

The estimated amount China alone will forego in national income between 2005–15 as a result of premature deaths caused by heart disease, stroke and diabetes

Drivers for consumer food product development

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- ▶ Growing population of unhealthy kids
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Unhealthy kids

- ▶ US data
 - High blood pressure – 3 fold increase in last 10 years
 - Cholesterol – 10% of children with 200 mg/dL
 - Metabolic syndrome – 1 million kids
 - Overweight – 30% kids
- ▶ AHA recommendations –
 - Begin monitoring blood pressure at age 3
 - Begin monitoring cholesterol at age 8 if there is a family history

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Consumer research – consumer would use food to prevent disease/health condition

Disease/health condition	%
Obesity	76
High cholesterol	67
Blood sugar imbalance	67
Heart disease	66
Diabetes	64
Lack of energy	58
Osteoporosis	48
Vision problems	38
Arthritis	35

Australian consumer – top 5 health concerns

- ▶ Cancer – 54%
- ▶ Tiredness – 48%
- ▶ Cardiovascular disease – 47%
- ▶ Stress – 43%
- ▶ Eye health – 41%

Market size – Australia & New Zealand

	AU	NZ
Population, million	~21.0	~4.3
Per capita GDP, US\$	~37,300	~27,200
Retail food market, A\$, billion	~107	~12.0
Functional foods (without health claims), A\$, million	~1200	~220
Nutritional supplements, A\$ million	~2200	~400
Nutraceuticals A\$, million	~950	~132

Average/estimated from various sources

Regulations - Functional Food Health Claims

Increasing degree of regulation

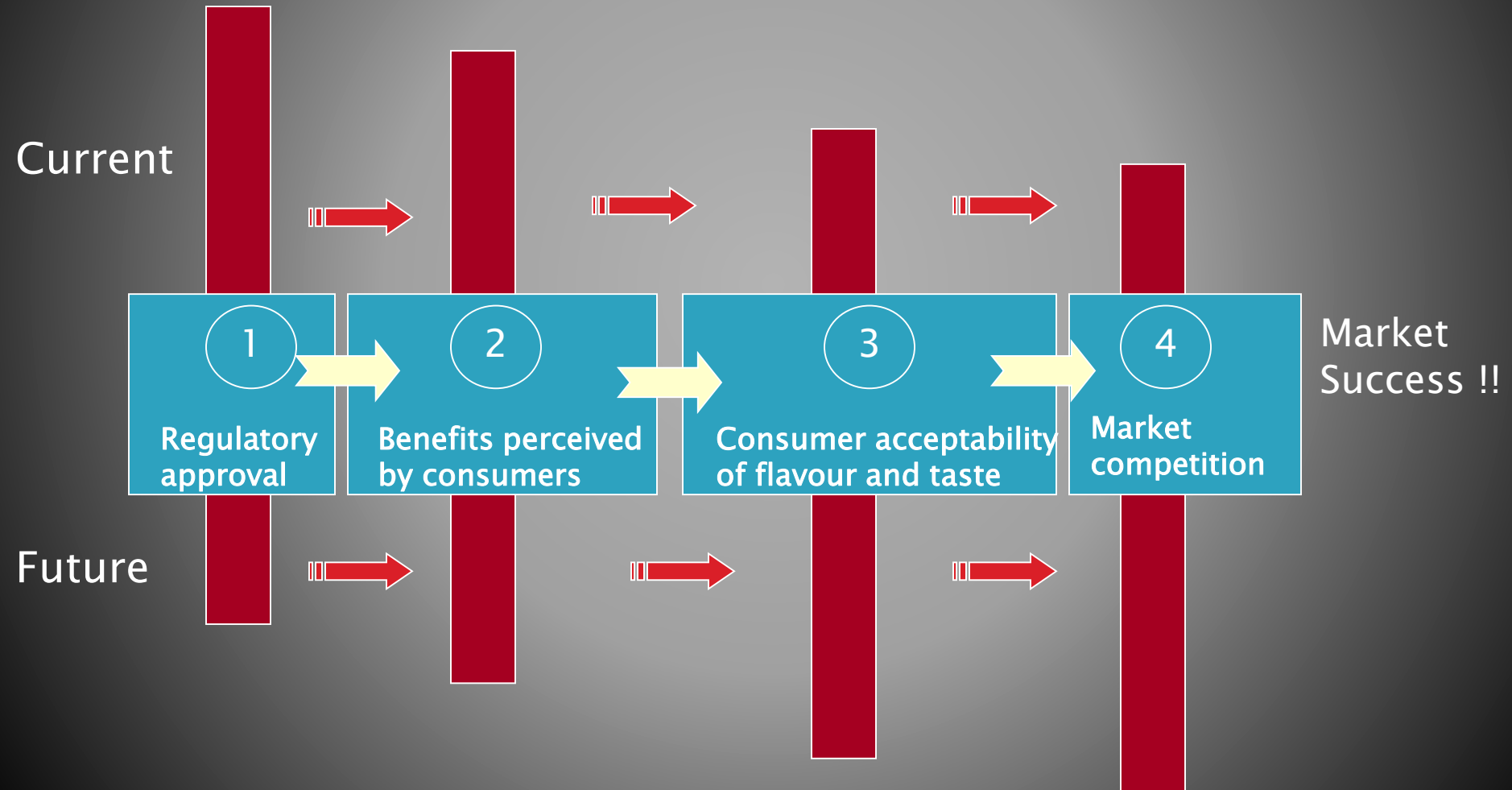


General level claims		High level claims
Content claims	General level health claims	
Absolute claims (e.g. “low fat”)	Function claims	Biomarker claims
Comparative claims (e.g. “reduced fat”)	Enhanced function claims	Risk reduction claims

Regulations – Functional Foods

- ▶ New regulations coming in effect (delayed yet again until >April 2011..)
- ▶ Will see significant market opportunities for bioactive and nutraceutical ingredients in Australia and New Zealand
- ▶ Will see new opportunities for functional foods and beverages
- ▶ Opportunities for health claims

Functional food challenges



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Conclusions

- ▶ Trends towards foods and ingredients with health benefits for prevention of lifestyle-related diseases
 - Regulations under development
- ▶ Alternative technologies to heat pasteurisation
 - Limited commercial successes
 - HPP has a strong potential