



---

# ***Innovations in Functional Foods***

---

***Dr Michelle Siow***  
***Programme Chair (DPHM)***  
*School of Applied Science*  
*Republic Polytechnic*  
*Singapore*

# Definition of a Functional Food

---

“A **Functional Food** is similar in appearance to conventional foods, is consumed as a part of a normal diet and has demonstrated physiological benefits and/or reduces the risk of chronic disease beyond basic nutritional function”

*(Health Canada 1998)*

# Examples of Functional Foods

---

- Bran – oats, wheat...
- Fiber – soluble, insoluble...
- Modified oils – high oleic, low saturated...
- Soy proteins
- Grains – Buckwheat, Quinoa
- Lentils, chickpea, peas, beans
- Hemp, Flaxseed

# Definition of a Nutraceutical

---

“A **Nutraceutical** is a product isolated from foods but sold in powders, pills and other medicinal forms not generally associated with food and is demonstrated to have physiological benefits or provide protection against chronic diseases”

*(Health Canada 1998)*

# Examples of Nutraceuticals

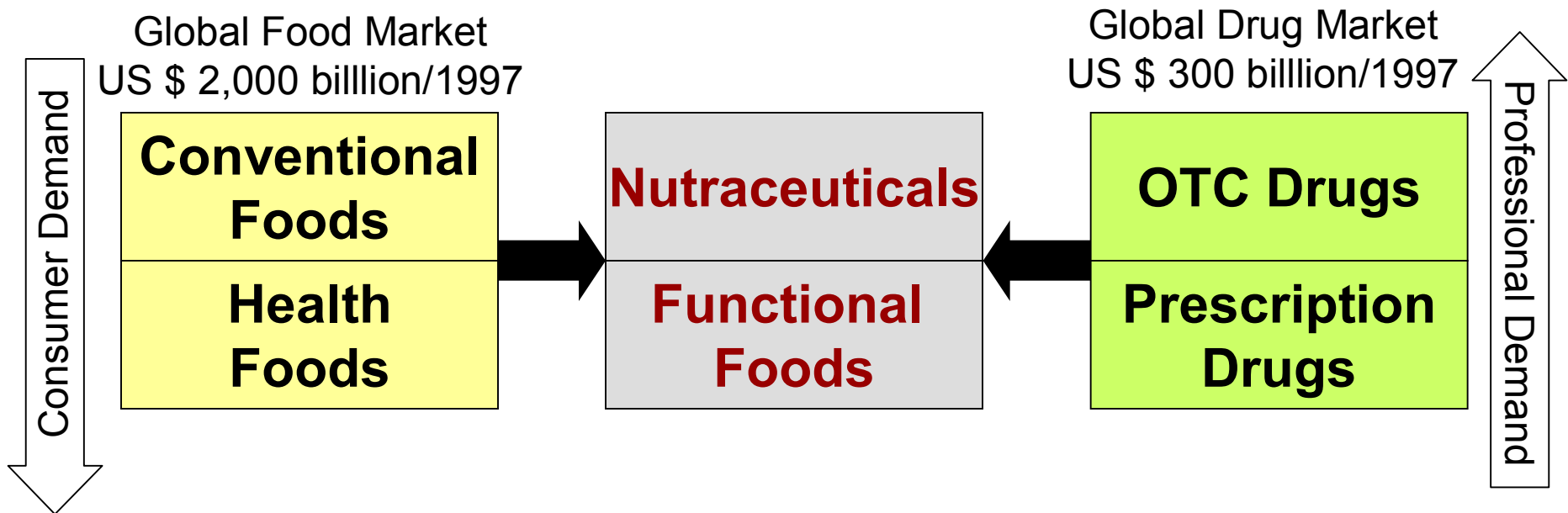
---

- Vitamin pills
- Mineral pills
- Herbal pills/supplements
- Oil gel caps
- Phytochemicals
- Zoochemicals

# Why Nutraceuticals & Functional Foods?

## The Food, Nutraceutical & Drug Market

---



After diagram in Forbes Medi-Tech  
Annual Report 1998

# Potential targets for functional food development

## Correlation between diet and disease

### Top 10 Principal Causes of Death in Singapore

- Cancer
- Ischaemic Heart Disease
- Pneumonia
- Cerebrovascular Diseases (Stroke)
- Accidents, Poisoning & Violence
- Other Heart Diseases
- Chronic Obstructive Lung Disease
- Diabetes Mellitus
- Urinary Tract Infections
- Nephritis, Nephrotic Syndrome & Nephrosis

### Diseases Most Affected by Diet

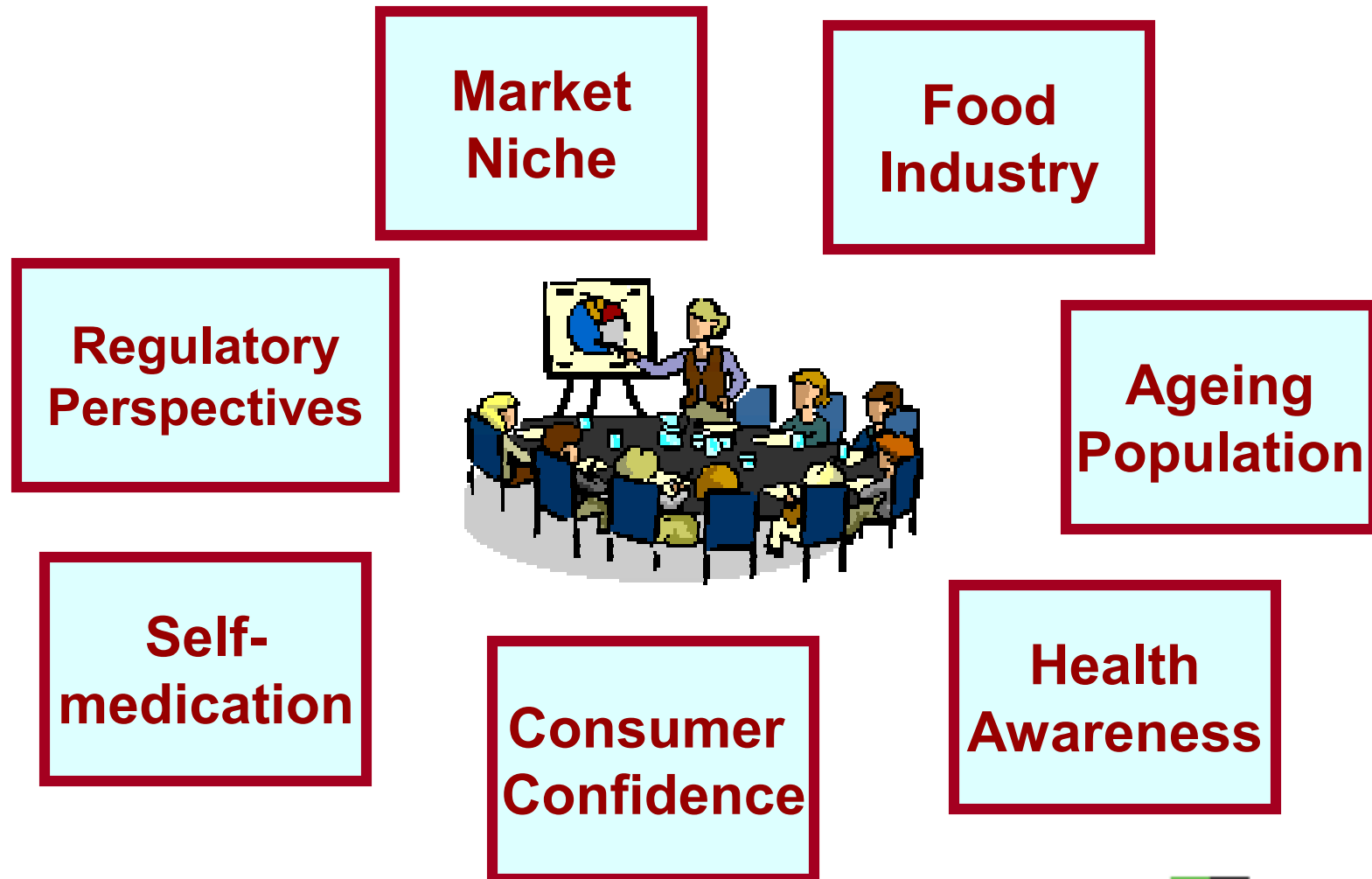
- Cancer
- High Cholesterol
- Coronary Heart Diseases
- Atherosclerosis
- Stroke
- Hypertension
- Diabetes (type II)
- Gastrointestinal Disorders
- Osteoporosis

<http://www.moh.gov.sg/corp/publications/statistics/principal.do>

Copyright © 2006 Republic Polytechnic, Singapore. All Rights Reserved

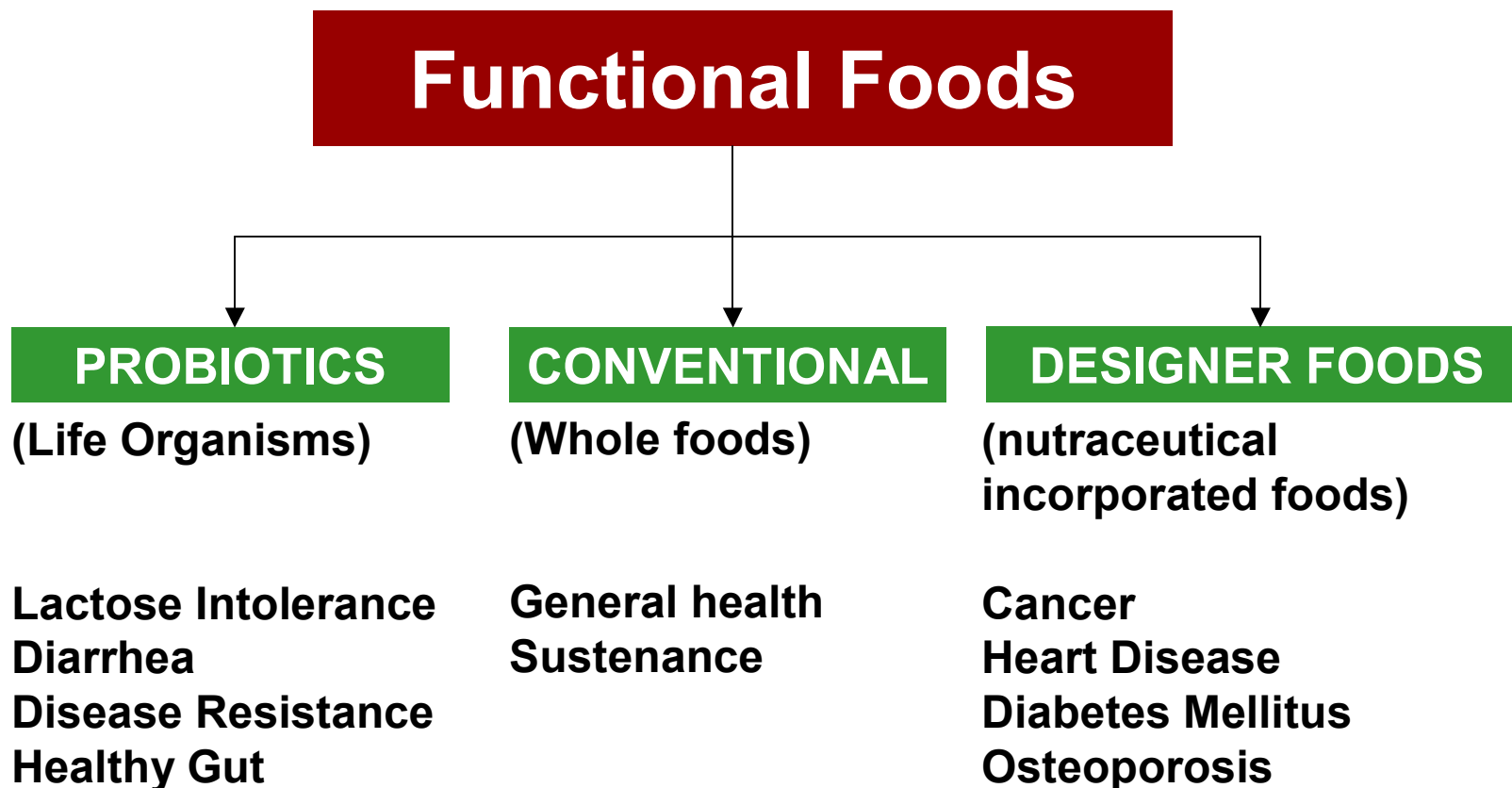
# Driving Force for the Nutraceutical/Functional Food Market

---



# Classification of Functional Foods

---



# Examples of Functional Food Components

Functional Component	Source	Potential Benefit
<b>Carotenoids</b>		
Alpha-carotene	carrots	• neutralize free radicals, which may cause damage to cells
Beta-carotene	fruits, vegetables	
Lutein	green vegetables	• reduce risk of macular degeneration
Lycopene	tomato products (ketchup, sauces)	• reduce risk of prostate cancer
<b>Dietary Fibre</b>		
Insoluble Fibre	wheat bran	• reduce risk of breast or colon cancer
Beta-Glucan	oats	• reduce risk of cardiovascular disease
Soluble Fibre	psyllium	
<b>Fatty Acids</b>		
Omega-3 Fatty Acids-DHA/EPA	tuna and other fish oils	• reduce risk of cardiovascular disease • improve mental, visual functions
Conjugated Linoleic Acid CLA	cheese, meat products	• improve body composition • decrease risk of certain cancers
<b>Flavonoids</b>		
Anthocyanidins	fruits	• neutralize free radicals; reduce risk of cancer
Catechins	tea	
flavanones	citrus	
flavones	fruits/vegetables	

International Food Information Council, 1999

Copyright © 2006 Republic Polytechnic, Singapore. All Rights Reserved



# Examples of Functional Food Components

Functional Component	Source	Potential Benefit
<b>Plant Sterols</b>		
stanol ester	corn, soy, wheat, wood oils	<ul style="list-style-type: none"> <li>• lower blood cholesterol levels by inhibiting cholesterol absorption</li> </ul>
<b>Prebiotics/Probiotics</b>		
Fructo-oligosaccharides (FOS)	Jerusalem artichokes, shallots, onion powder	<ul style="list-style-type: none"> <li>• improve quality of intestinal microflora; gastrointestinal health</li> </ul>
Lactobacillus	yogurt, other dairy	
<b>Soy Proteins: Phytoestrogens</b>		
Isoflavones: <ul style="list-style-type: none"> <li>• Daidzein</li> <li>• Genistein</li> </ul>	soybeans and soy-based foods	<ul style="list-style-type: none"> <li>• menopause symptoms, such as hot flashes</li> <li>• protect against heart disease and some cancers; lower LDL and total cholesterol</li> </ul>
Lignans	flax, rye, vegetables	
<b>Tannins</b>		
Proanthocyanidins	cranberries, cranberry products, cocoa, chocolate	<ul style="list-style-type: none"> <li>• improve urinary tract health</li> <li>• reduce risk of cardiovascular disease</li> </ul>

International Food Information Council, 1999

## Potential health attributes of food ingredients ...

Ingredient	Potential Health Attributes
Calcium	Prevention of Osteoporosis Promotes healthy bones and teeth Protective against hypertension
Folic Acid	Protective against neural tube defects
Vitamin E	Protective against Heart Disease Protective against Cancer
Iodine	Protective against Goitre
Immuno-peptides	Protective against Cancer
Casein Phosphopeptides	Promotion of Calcium Absorption
Lactoperoxidase	Prevention of dental caries
Lactoferrin	Prevention of dental caries Prevention of gastro-intestinal infection Leukaemia therapy
Modified $\beta$ -Lactoglobulin	Prevents milk protein allergies
Lactic Acid Bacteria	Promote a healthy gut
Immunoglobulins	Prevention of dental caries Prevention of gastro-intestinal infection Lowering of Cholesterol

International Food Information Council, 1999

Copyright © 2006 Republic Polytechnic, Singapore. All Rights Reserved





---

***Some Examples of  
Functional Food Products***

---

# Prebiotic/Probiotic Food Products

---



# Some Functional Foods from Sweden



**ProViva yoghurt**



**ProViva Active**



**ProViva fruit drink**



**Primaliv**

Fermented milk  
and oatsbran



**Hjärtans  
Lust**



**ProViva Shot**

# Some Australian Functional Food brands ...

---

- Many brands are iconic household names in Australia



# How about the local scene?

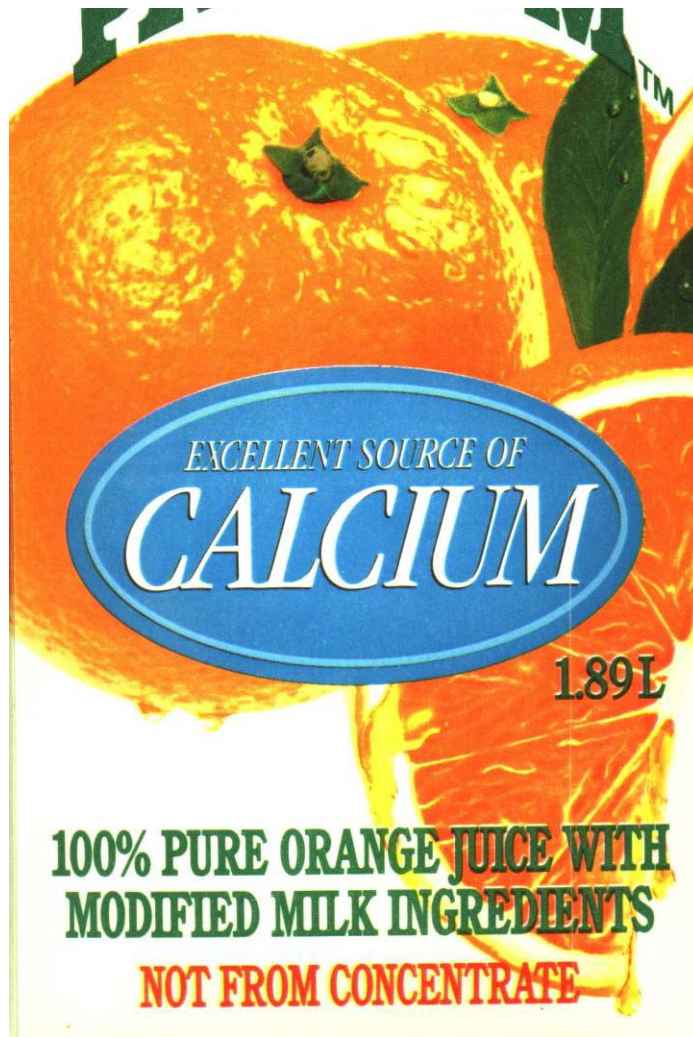
---

## ***Functional Foods***

*High Dose Calcium Chocolates  
Nutraceuticals in Ice Cream  
Nutraceuticals in Isotonic Drinks  
Lollipops for Sore Throat Relief*



# As an example ...



*Florida Premium™ is proud to offer you a new orange juice with modified milk ingredients, making it an excellent source of calcium.*

*Florida Premium™ is a logical choice within a well-balanced diet, especially since calcium helps develop and maintain sound bones and healthy teeth.*

*Each serving is an excellent source of calcium and vitamin C.*

*Florida Premium™, made with pure passion!*

Keep refrigerated (0°C to 4°C)      Garder réfrigéré (0°C à 4°C)

QUALITÉ GARANTIE À 100% GUARANTEED QUALITY

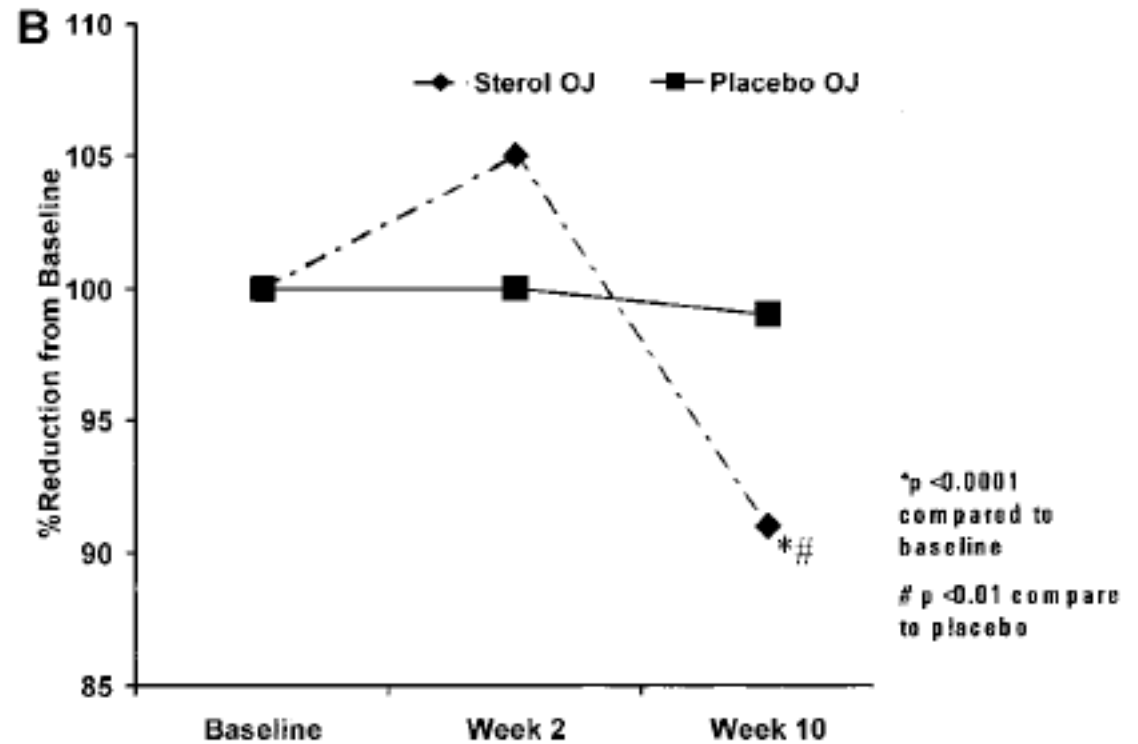
RETOURNABLE LA OU PRESCRIT  
REFUND WHERE APPLICABLE

Prepare par/Prepared by:  
A. LASSONDE INC.  
ROUJEMONT, QUÉBEC  
CANADA J0L 1M0  
MONTREAL, TORONTO, HALIFAX

0 67311 05289 0

05289-8-101

... it needs to be *functional* ...

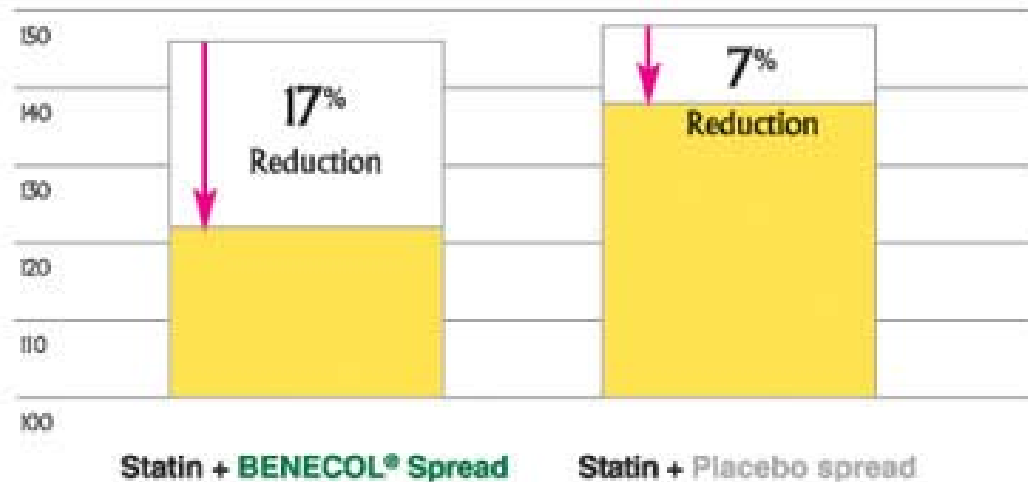


Devaraj et al, *Arterioscler Thromb Vasc Biol*, 2004



**Active Ingredient:**  
Plant Stanol esters,  
which are extracted  
from pine tree pulp.

**The Promise:**  
Benecol lowers  
cholesterol.



**10% difference in  
LDL reduction  
(mg/dL) between  
groups (p<0.0001)**

Blair, SN, Capuzzi, DM, Gottlieb, SO, et al., *Am. J. Cardiol.* 2000;86:46-52.

Copyright © 2006 Republic Polytechnic, Singapore. All Rights Reserved

# Applying scientific research to the development of 3G functional foods ...

## 1st generation

### *supplements*

- vitamin supplements
- calcium enrichment
- fibers

- Components with established efficacy
- Research based on epidemiology

## 2nd generation

### *whole foods*

- broccoli
- yoghurts
- green tea
- whole grain products

- Research based on safety and efficacy assessment: 'discovery' of positive effects of food components
- Active component(s) may not have been identified or the efficacy confirmed

## 3rd generation

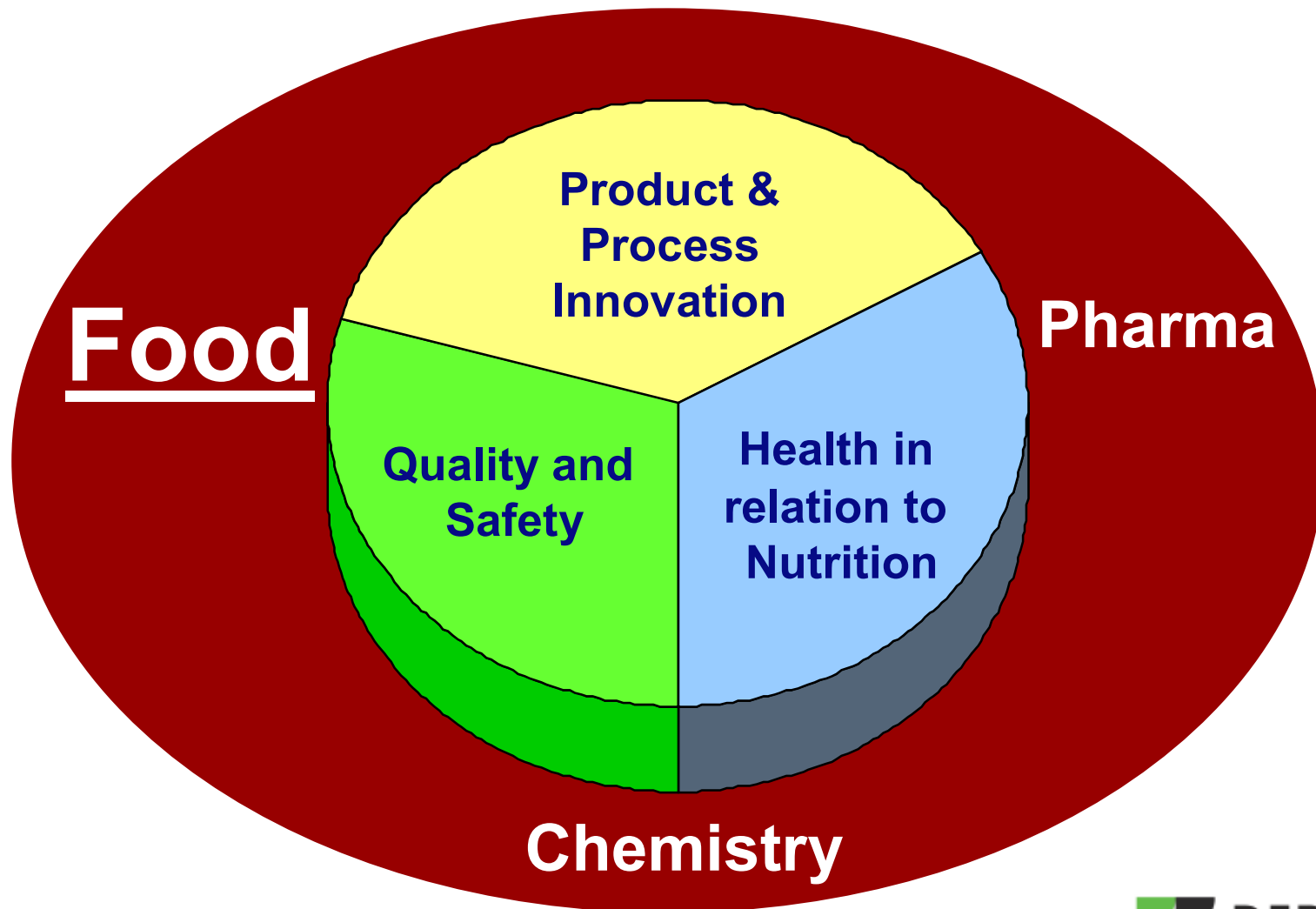
### *enhanced foods*

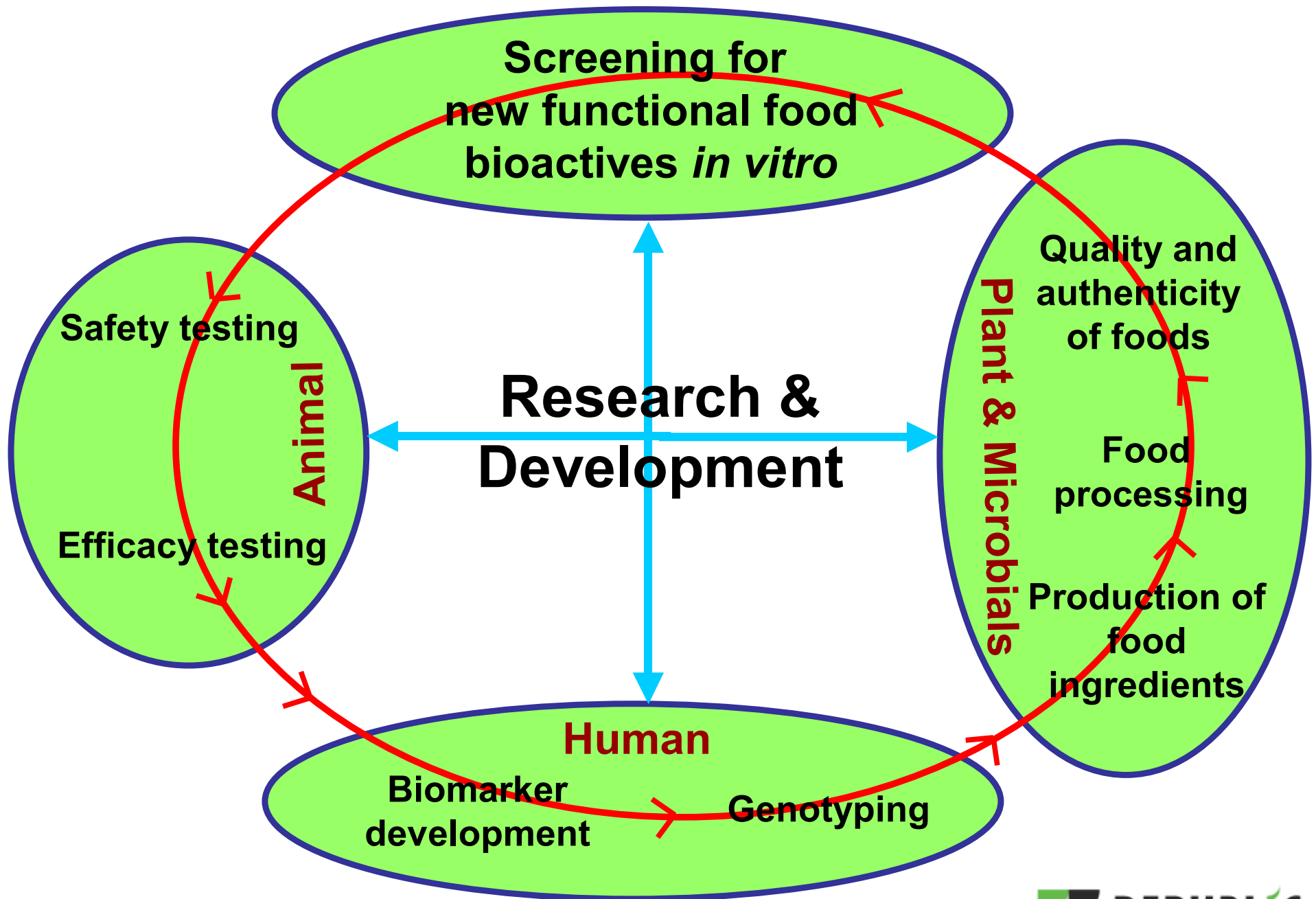
- novel ingredients?
- novel products?
- ??

- Newly developed functional ingredients / foods based on mechanistically proven efficacy
- Research based on 'pharma' type of screening: effect targeted development, lead optimization, bioavailability

# Collaborative research efforts ...

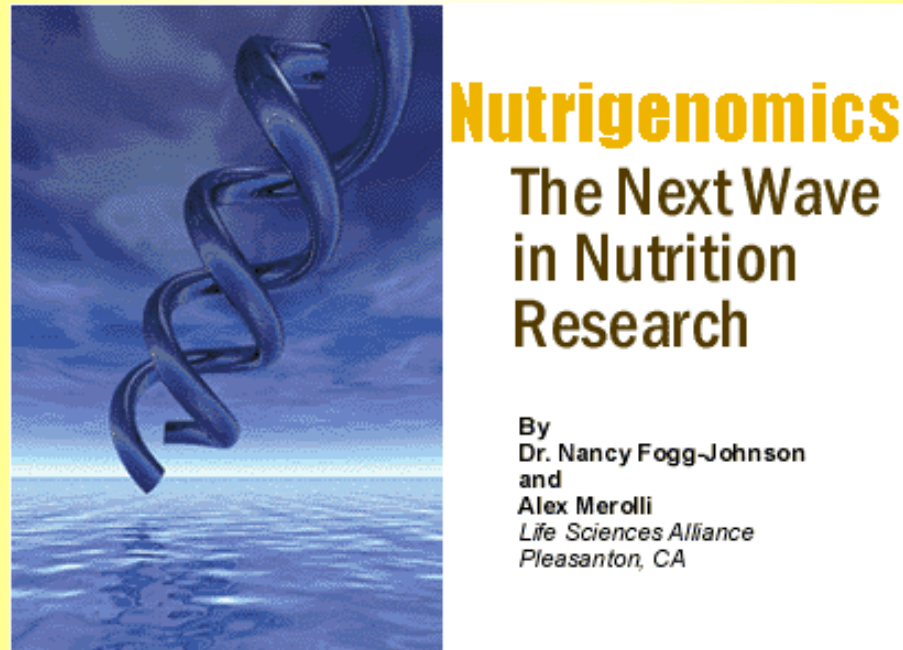
---





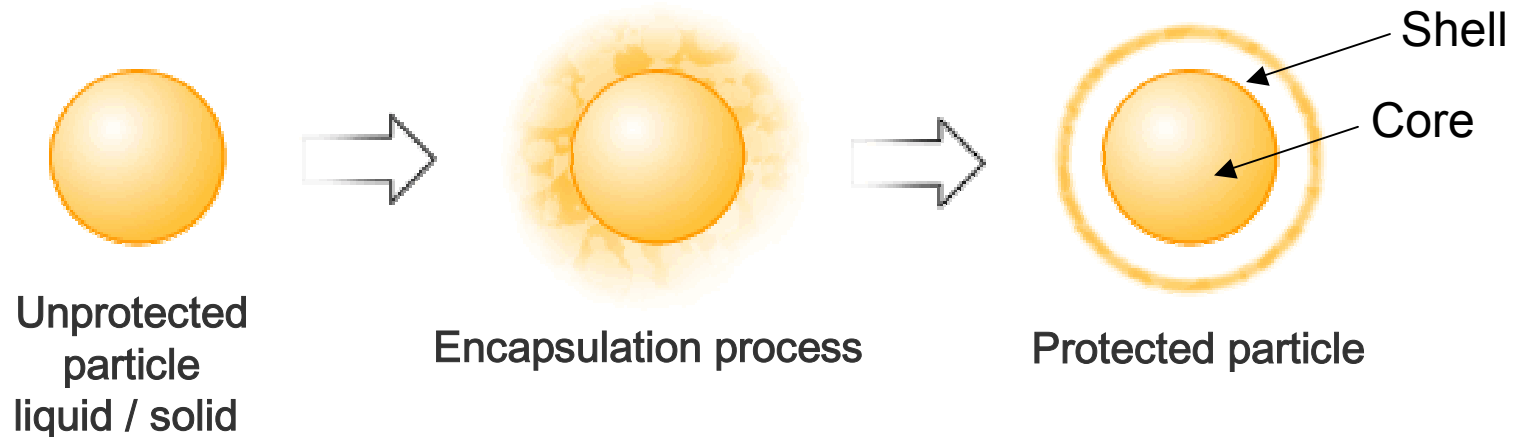
# Science of nutrition and genomics driving the emergence of functional food products ...

---



**The study of how different foods may interact with specific genes to prevent chronic diseases such as type 2 diabetes, obesity, heart disease, stroke and certain cancers.**

# Microencapsulation offers ability to develop innovative products...



Spray Drying  
Spray Chilling  
Pan Coating  
Air-suspension Coating  
Centrifugal Extrusion  
Polymerisation

- Controlled/delayed release of active ingredients
- Coating liquid substances
- Masking flavours, smell & colour
- Protecting core material
- Reducing volatility
- Stabilising to improve shelf-life

# Analytical capabilities as a means to improve and ensure quality...

---

- Ultraviolet-visible spectrometer
- Fourier transform infrared (FTIR)
- High performance liquid chromatography (HPLC)
- Differential scanning calorimetry (DSC)
- Thermogravimetric analyzer (TGA)
- Liquid chromatography/mass spectrometer (LC/MS)
- Particle size analyzer
- Optical and electron microscopes
- Dissolution tester
- Hardness tester
- Viscometer
- Texture analyzer



# Research Challenges

---

- Public health education
- Investment to bridge research gaps
- Lack of knowledge in intellectual property protection
- Insufficient co-ordination of research activities
- Limited financial resources
- Need for scientifically-trained personnel

*Thank You!*

Any questions?