

# Session II, Food R&D

*Prof Martin Cole, PhD*

*The Role of R&D in Agriculture  
and Related Industries: Today  
and Tomorrow, Federal  
Reserve Bank of Chicago,  
September 2007*



**National Center for Food Safety and Technology**

Working Together to Assure the Safety of Our Food Supply [www.ncfst.iit.edu](http://www.ncfst.iit.edu)

ILLINOIS INSTITUTE  
OF TECHNOLOGY



# Outline

- Food Business
- Innovation
- Consumer Trends
- Food Safety & Globalization
- Opportunities from technology
- Wrap-Up, Opportunities for Illinois

# 'The Food Industry is a Huge Business'



Global Processed food sales \$3.2 trillion

U.S. agriculture has a \$1.24 trillion value (13% GDP)

Provides 22 percent of all jobs

Production exceeds \$200 billion (\$60 billion in exports)

Production: Over 2 million farms

Processing: 57,000 food facilities

Distribution

Transportation

Retail: Over 1.2 million operations

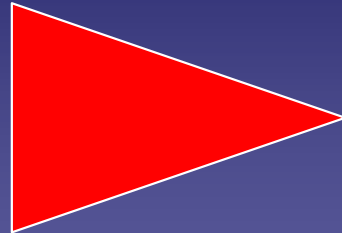


# Drivers in the food industry

**Global  
retailers**

5-7 by 2010

Wal Mart  
US\$ 350Bn



**Food  
manufacturers**

Nestle  
US\$80Bn



**SMEs**

- Significant difference in size between the largest retailer and the largest manufacturer
- Global retailers have the power, individually and through buying alliances
- Rapid consolidation of retailers and the introduction of private labels are key drivers

# Huge Market Growth Potential from Poverty Reduction

| Country      | Pop'n (000) | % < \$1/day | % < \$2/day |
|--------------|-------------|-------------|-------------|
| <b>China</b> | <b>1299</b> | <b>16.6</b> | <b>46.7</b> |
| <b>India</b> | <b>1065</b> | <b>34.7</b> | <b>79.9</b> |
| Indonesia    | 239         | 7.5         | 52.4        |
| Brazil       | 184         | 8.2         | 22.4        |
| Pakistan     | 159         | 13.4        | 65.6        |
| Russia       | 144         | 6.1         | 23.8        |
| Bangladesh   | 141         | 36.0        | 82.8        |
| Nigeria      | 126         | 70.2        | 90.8        |
| Mexico       | 105         | 9.9         | 26.3        |

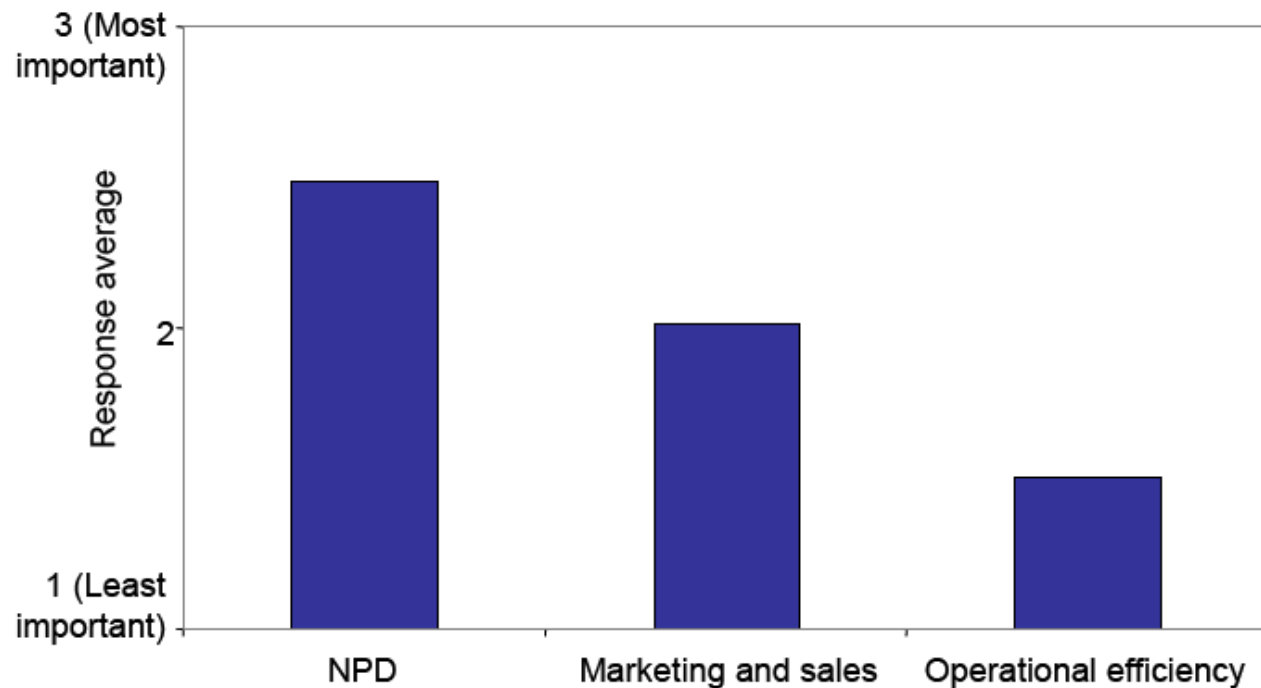
Source: World Bank. [World Development Indicators](#) database (Bob Thompson, UI)

# Global Demographics & Food Trends

- **Larger Fraction of World Food Production to Move Through Trade**
  - *The world's arable land and fresh water are not distributed around in the world in the same proportions as is population.*
- **Processed Food Trade Growing Even Faster now  $\frac{3}{4}$  of global agricultural trade and growing twice as fast as raw commodity trade due to**
  - *Lower barriers to flow of capital, information; goods and services*
  - *Technological advances*
  - *Global extension of supply chain*
  - *Consolidation*
  - *Foreign direct investment*
  - *Increased consumer purchasing power drives demand for "quality" and diversity*

(Adapted from Bob Thompson, UI)

**Figure 2.3: Areas of investment important for building a competitive position over the next 5 years**



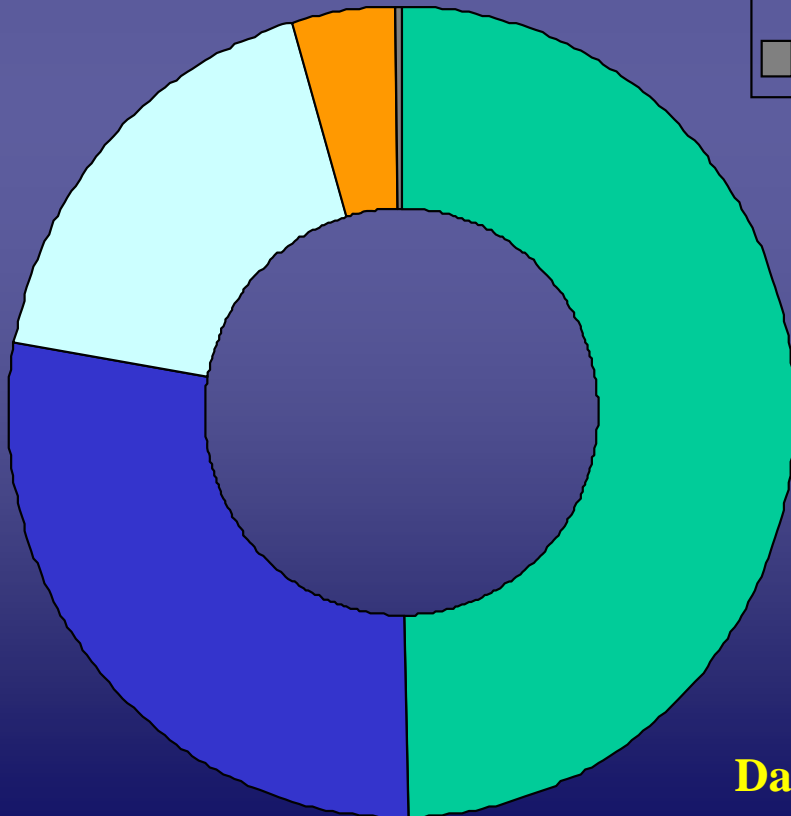
Note: Respondents were asked to rank the importance of 3 investment areas on a scale of 1 which was least important to 3 which was most important. The response average is an average of the rankings given along the scale.

# Drivers of innovation

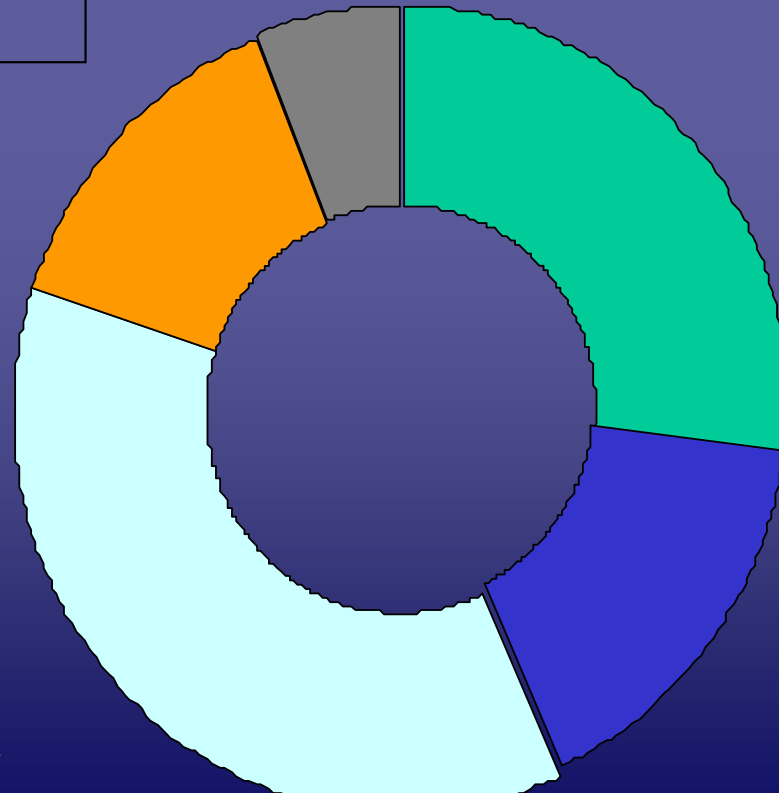
## New product success after 12 months



Me-too's

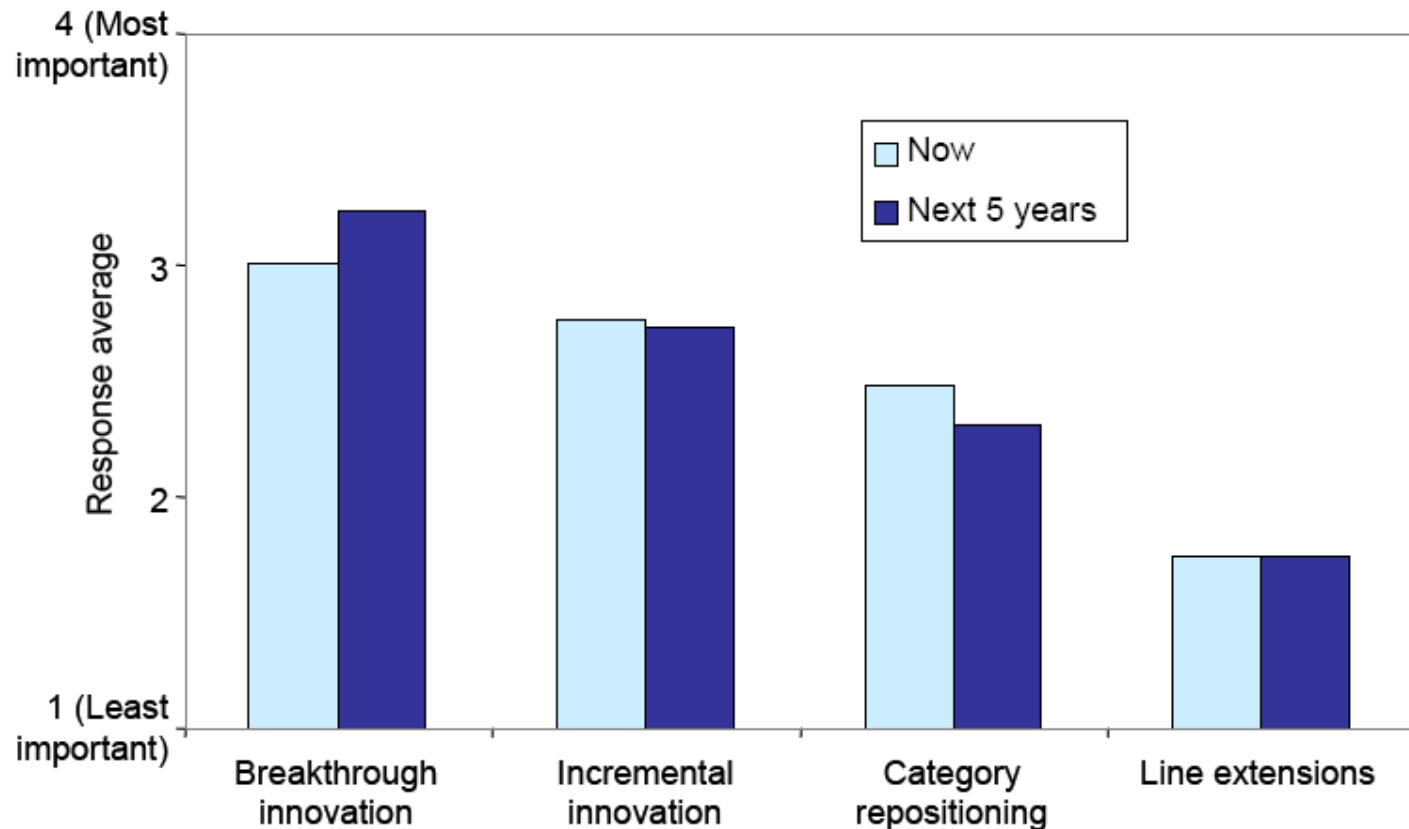


Wholly new products



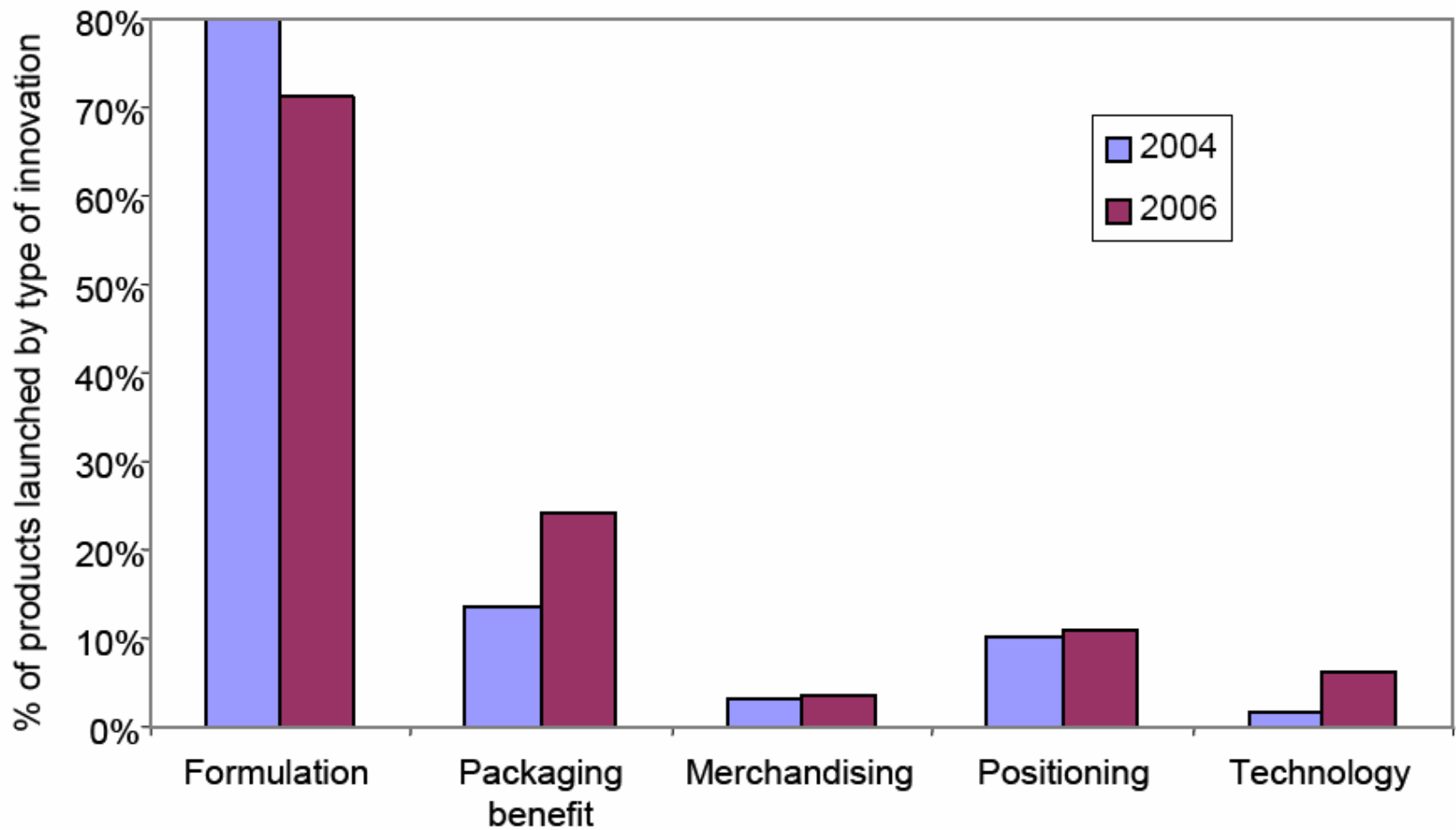


**Figure 3.18: The types of innovation most important for food and drinks NPD today and in the next 5 years**



Note: Respondents were asked to rate importance on a scale of 1 which was least important to 4 which was most important. The response average is an average of the ratings given along the scale.

**Figure 4.24: Innovation by type, 2004-2006 (%)**

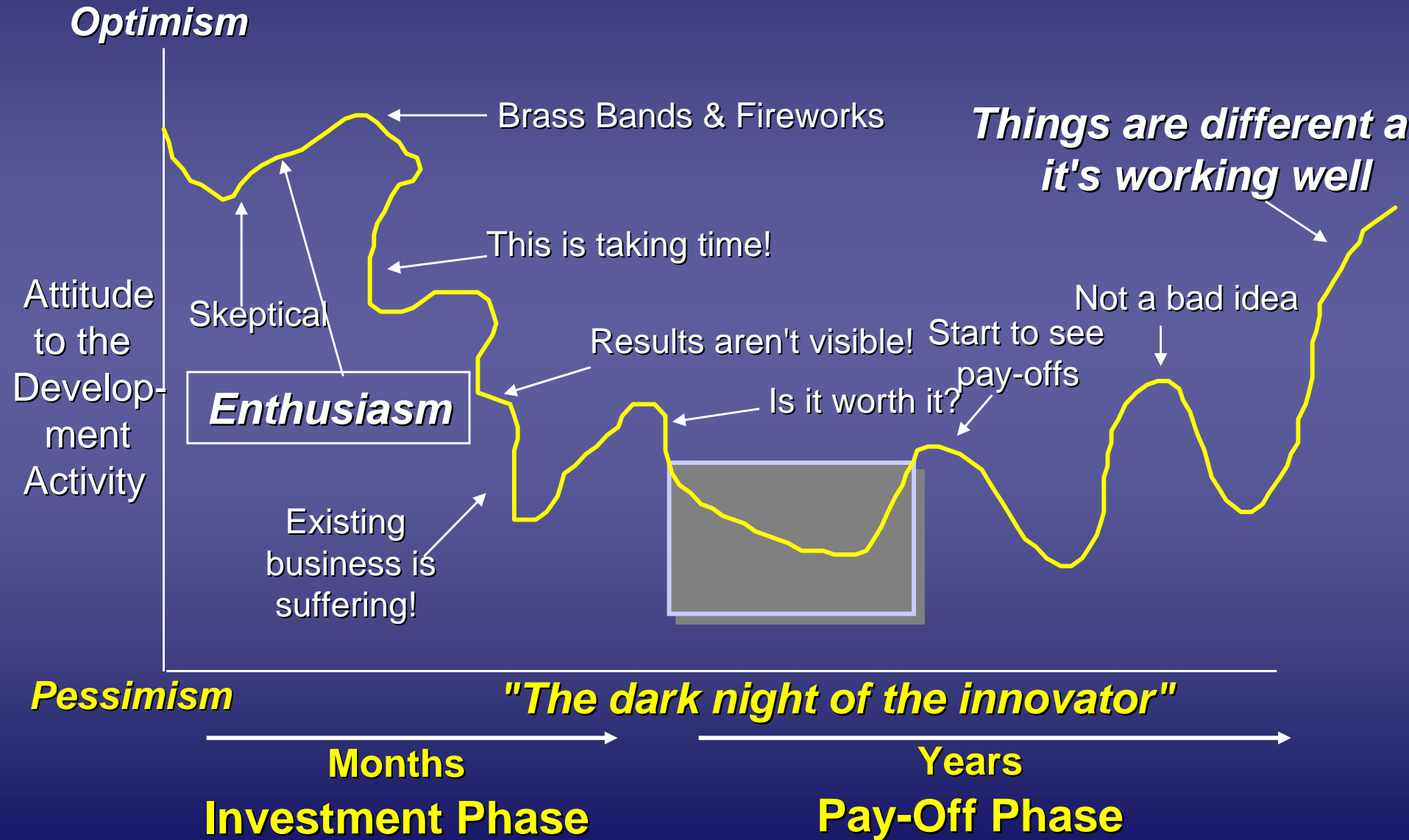


Note: Year ends November 1st 2006

Source: Productscan

Business Insights Ltd

# Innovation Requires Investment and Patience



# Food Industry R&D Investment

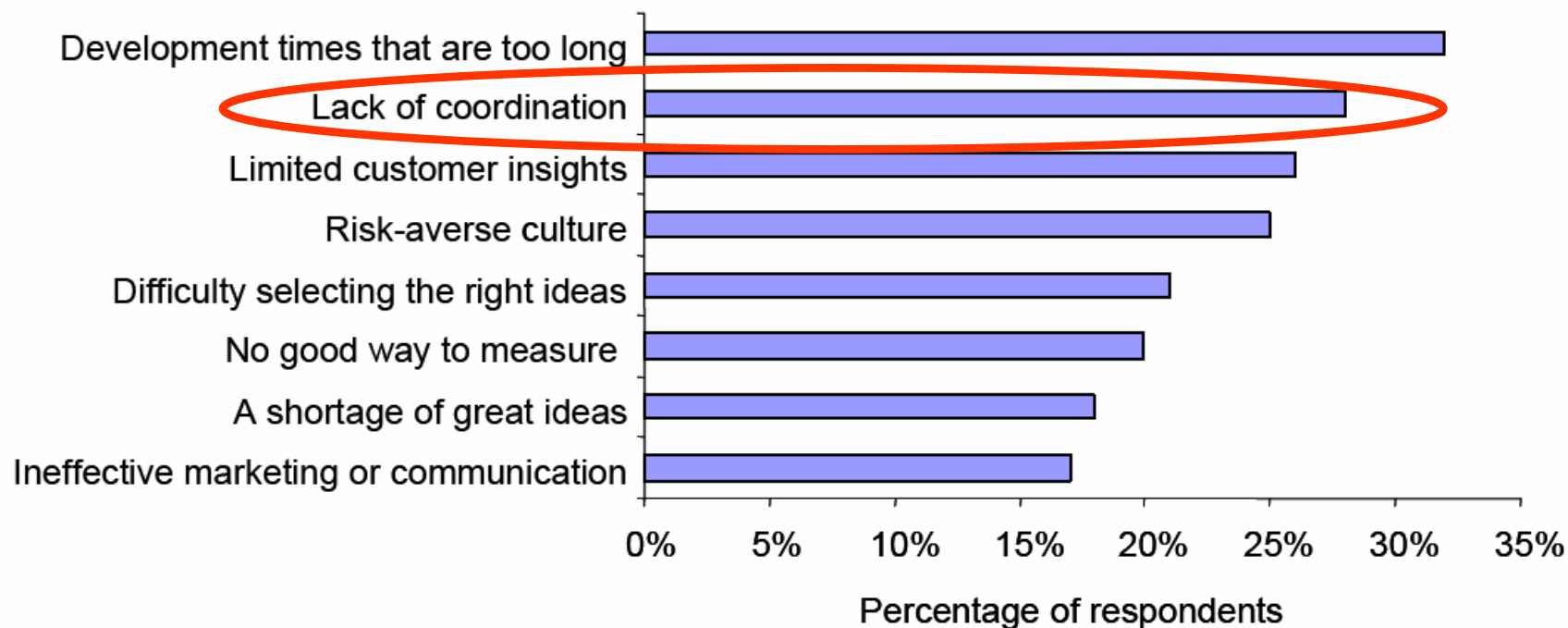
**Table 4.1**  
The largest sectors by aggregate R&D Investment from the world top *Scoreboard* companies, in 2004

| Rank | Sectors                                | Total R&D investment (€ m) | Sector share (%) | R&D Investment /company (€ m) |
|------|--|----------------------------|------------------|-------------------------------|
| 1    | Automobiles & Parts (65)               | 58516                      | 19.0             | 900.3                         |
| 2    | IT Hardware (169)                      | 57351                      | 18.6             | 339.4                         |
| 3    | Pharmaceuticals & Biotechnology (121)  | 56028                      | 18.2             | 463.0                         |
| 4    | Electronic & Electrical Equipment (78) | 34652                      | 11.2             | 444.3                         |
| 5    | Software & Computer Services (80)      | 19625                      | 6.4              | 245.3                         |
| 6    | Chemicals (80)                         | 15656                      | 5.1              | 195.7                         |
| 7    | Aerospace & Defence (24)               | 11718                      | 3.8              | 488.2                         |
| 8    | Engineering & Machinery (68)           | 9015                       | 2.9              | 132.6                         |
| 9    | Health (36)                            | 6343                       | 2.1              | 176.2                         |
| 10   | Telecommunication Services (18)        | 6329                       | 2.1              | 351.6                         |
| 11   | Diversified Industrials (18)           | 5891                       | 1.9              | 327.3                         |
| 12   | Oil & Gas (23)                         | 4279                       | 1.4              | 186.0                         |
| 13   | Personal Care & Households (15)        | 3646                       | 1.2              | 243.1                         |
| 14   | Media & Entertainment (13)             | 3624                       | 1.2              | 278.7                         |
| 15   | Food Producers (15)                    | 3162                       | 1.0              | 210.8                         |
|      | Total 15 Sectors (823)                 | 295835                     | 35.8             | 359.5                         |
|      | Rest of 16 Sectors (119)               | 12813                      | 4.2              | 107.7                         |
|      | TOTAL 942 companies                    | 308648                     | 100,0            | 327.7                         |

- Food Companies rank lowest in R&D Investment
- Also least profitable!
- But Food R&D increased by 6.3%(double average!)
- Government programs
  - EU 61M Euro 5 Food Project Institute of Technology
  - Australia, Food Innovation Grants and CSIRO Flagship
  - India, Knowledge Council

*European Commission (2005),  
Monitoring industrial research: the 2005 EU industrial R&D  
Investment SCOREBOARD.*

**Figure 2.5: Obstacles to innovation**



Source: BCG Innovation 2006 Survey

Business Insights Ltd

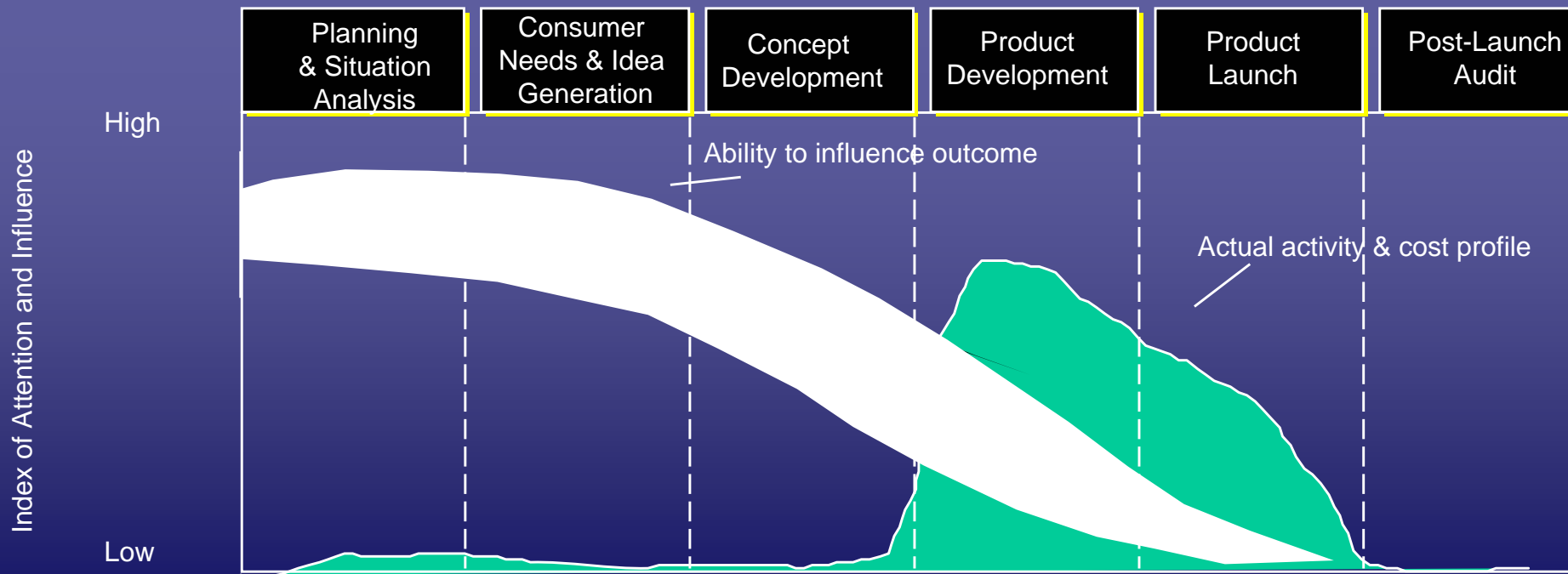
# Managing the risk of Innovation'

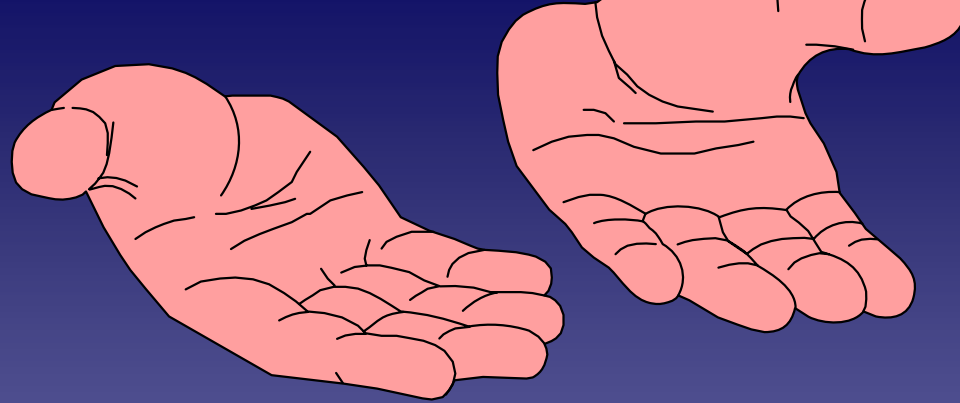
□ The opportunity to influence the success of a new product is greatest in the early stages

□ Innovation is about being 'brave' not 'foolish'

□ Collaboration in pre-competitive validation stage helps to reduce risk

## Importance of the Front-End





***Consumers are demanding miracle foods that are totally natural, have zero calories, zero fats and cholesterol, delicious taste, total nutrition, low price, environmentally friendly production, 'green' packaging....and that guarantee perfect bodies, romance and immortality***

**(Carol Brookins, Global Food and Agriculture Summit, 1999)**

# Consumer Drivers

the Current Mega-Trends

SAFETY

'a given'

Consumer  
'well-being'

Health

Convenience

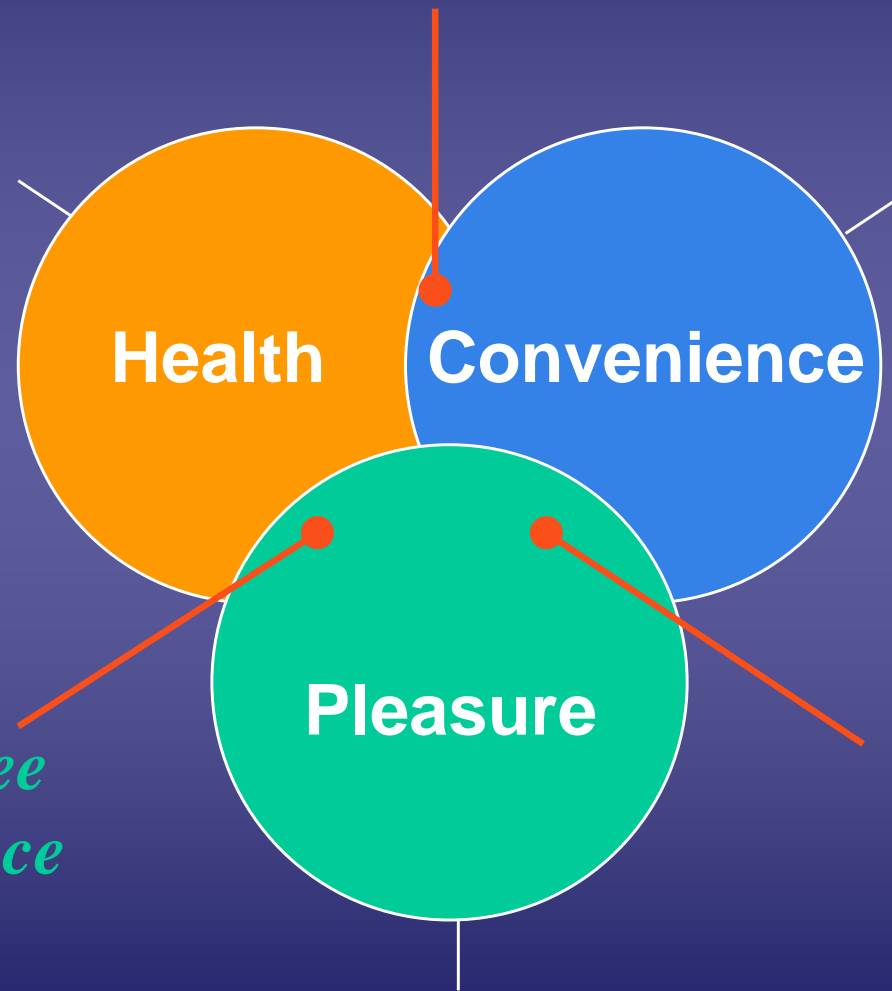
'Time factor'

Pleasure

*Guilt-free  
indulgence*

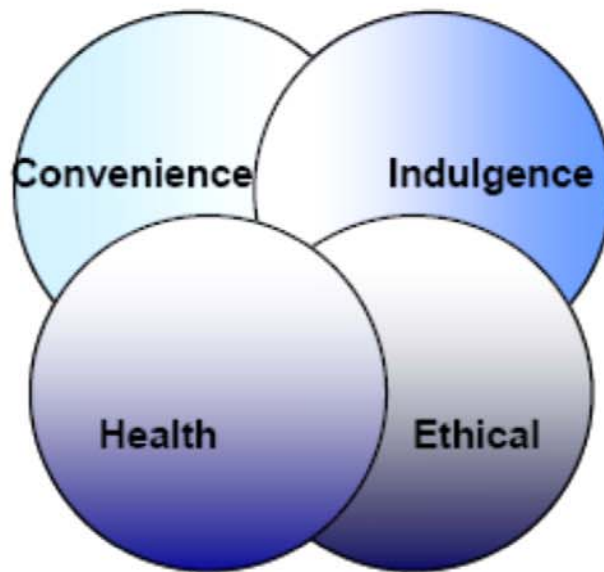
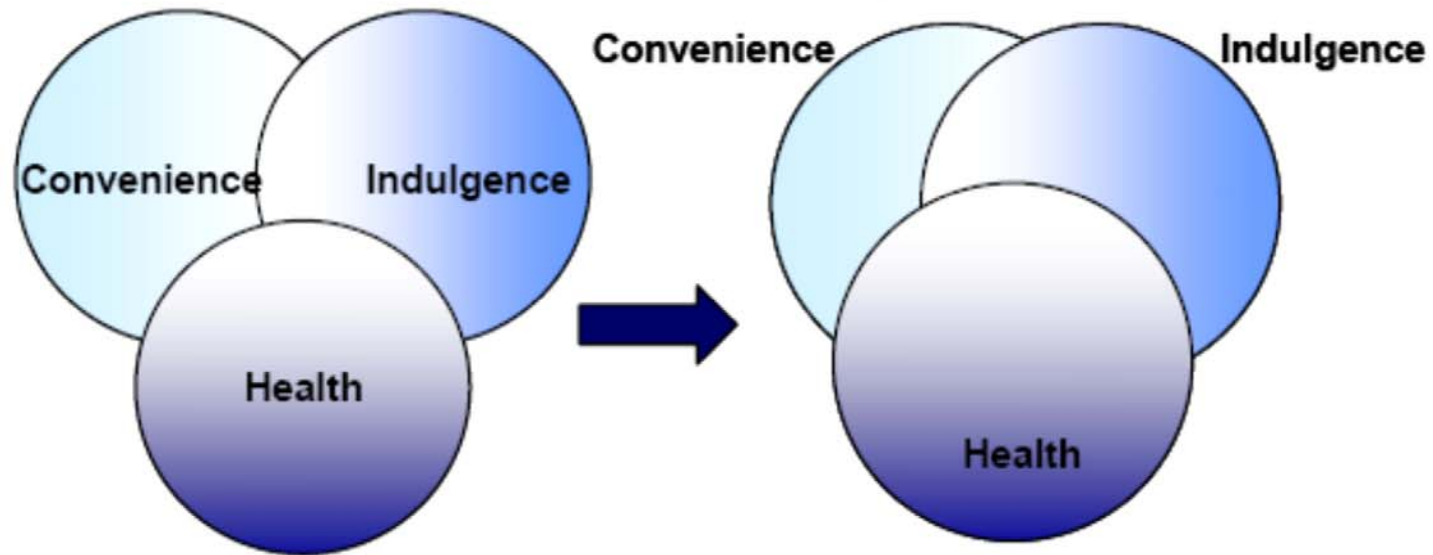
*Convenience  
plus*

Sensory experience





Increasing convergence of  
convenience, health and premium



Emergence of ethical  
and convergence with  
other trends

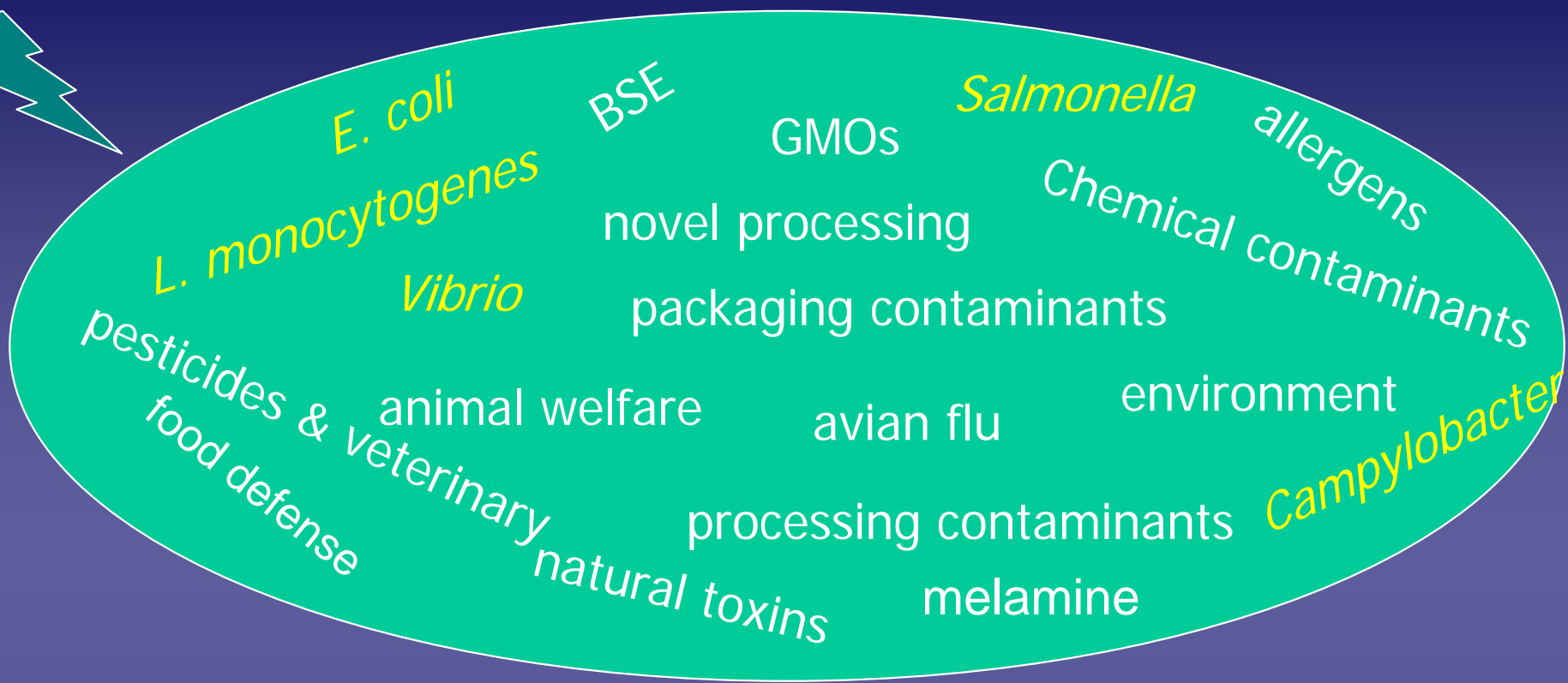
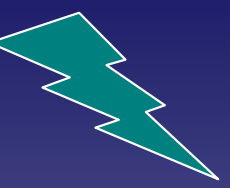
A thick blue curved arrow points from the top diagram down to the bottom diagram, indicating a transition or a new trend emerging from the previous state.

# Globalisation – Implications

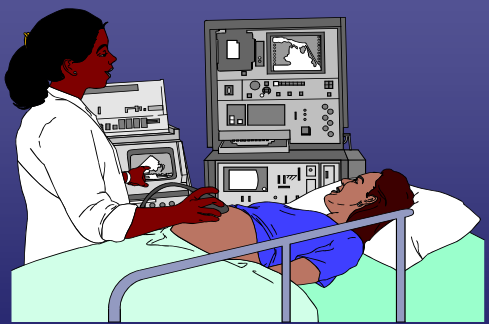
- International sourcing → complex supply chains → sophisticated management required
- Potential for large and widespread outbreaks
- Cross-border translocation of infectious agents
- International regulatory harmonisation essential



# Risk: Industry/Company Perspective



'Real'



VS

'Perceived'

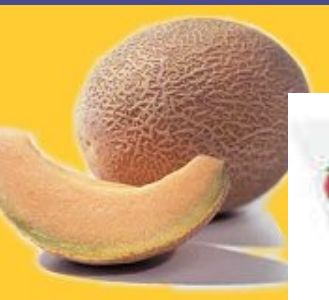


= Business Risk

# Food Safety: Fresh Produce Example

(Dave Gombas, United Fresh Produce Association)

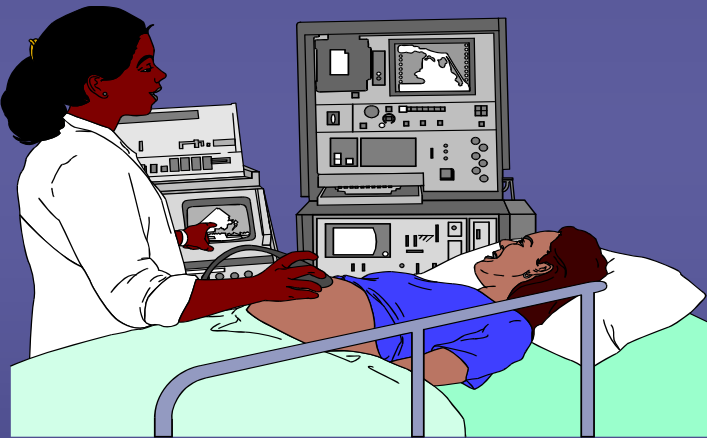
- Includes over 300 separate commodities
- Food safety often relies on prevention of contamination, the weakest form of hazard control
  - Control of pathogen growth is insufficient
  - No practical “kill” step currently available
- Leafy greens 5 million bags a day, 18 billion/year



# Government Perspective

- *Primary role is to protect safety of its consumers*
- *Secondary role to facilitate trade*

## Public Health



VS

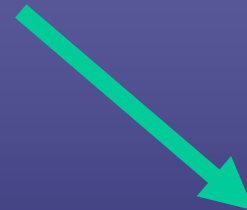
## Trade



- Microbiological
- Chemical
- Physical
- **Nutrition Related** (*Linked to chronic illness*)

# Reforms to Managing Food Safety

Command & Control  
Prescriptive  
Point Testing  
Constraint to Innovation



Risk based  
Flexible  
Through Chain  
Supports Innovation  
More Complex

# Food Processing Balance



**Need to destroy**  
**Pathogens**  
**Spoilage Organisms**  
**Enzymes**

**VS**

**Optimise**  
**Flavour**  
**Texture**  
**Colour**  
**Nutritional quality**



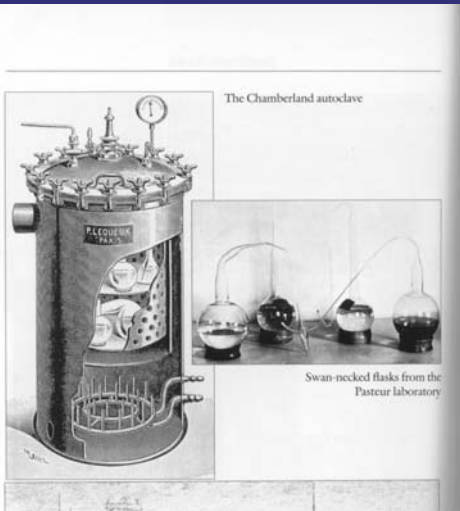
‘Food companies and regulators are beginning to understand the potential benefits that technologies such as ozone, high pressure, pulsed electric field, aseptic packaging, irradiation and ultrasound offer- fresher tasting foods that retain nutritional value and are safe.’

*Editor FoodSafety Magazine, November, 2003*



# New Food Safety Technologies

## e.g. Non-Thermal



Ultra high pressure



UV Light

Pulsed electric field

# Product Examples: Fruit & Fruit Products

## Key Drivers

Freshness & Convenience



## Outputs & Outcome

Minimal effect on  
texture/flavour/nutrition  
Extended shelf-life

Food Safety Concern  
*E.coli/Salmonella*



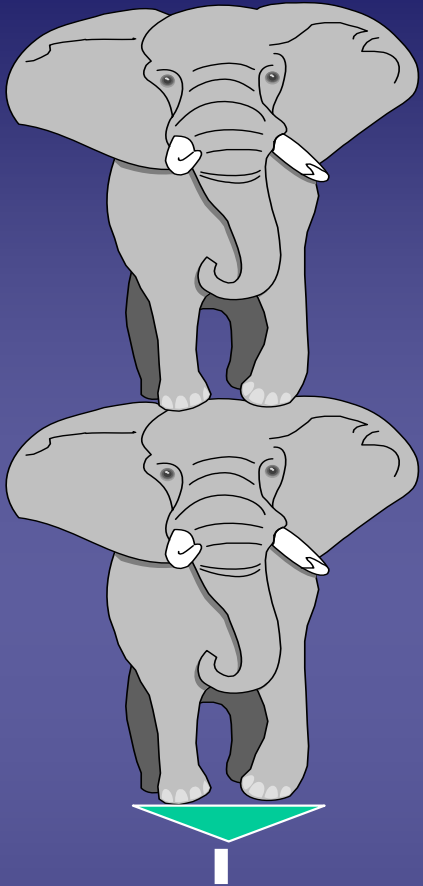
Enhanced Safety  
'Cold Pasteurisation'

## Research Challenges

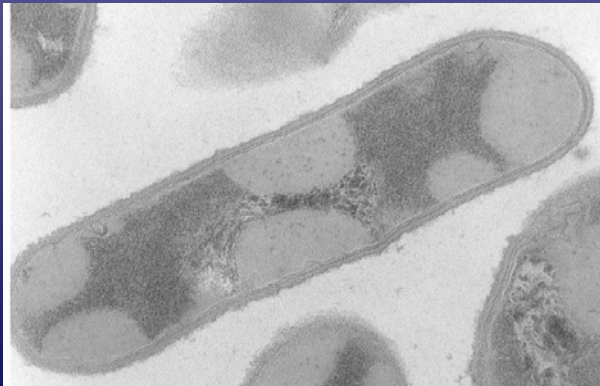
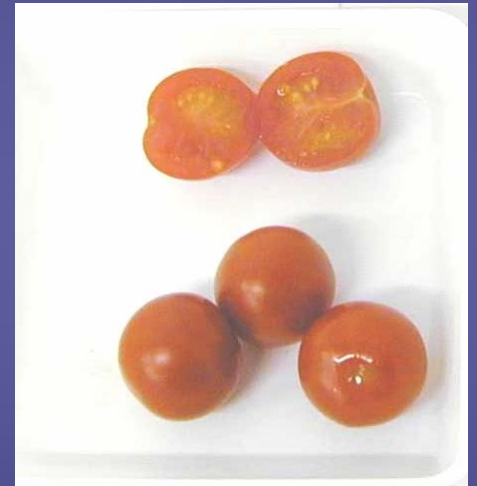
Enzyme inactivation/inhibition  
Validation of bacterial kill step  
Packaging and distribution  
Shelf-life & Sensory Studies



# Ultra High Pressure

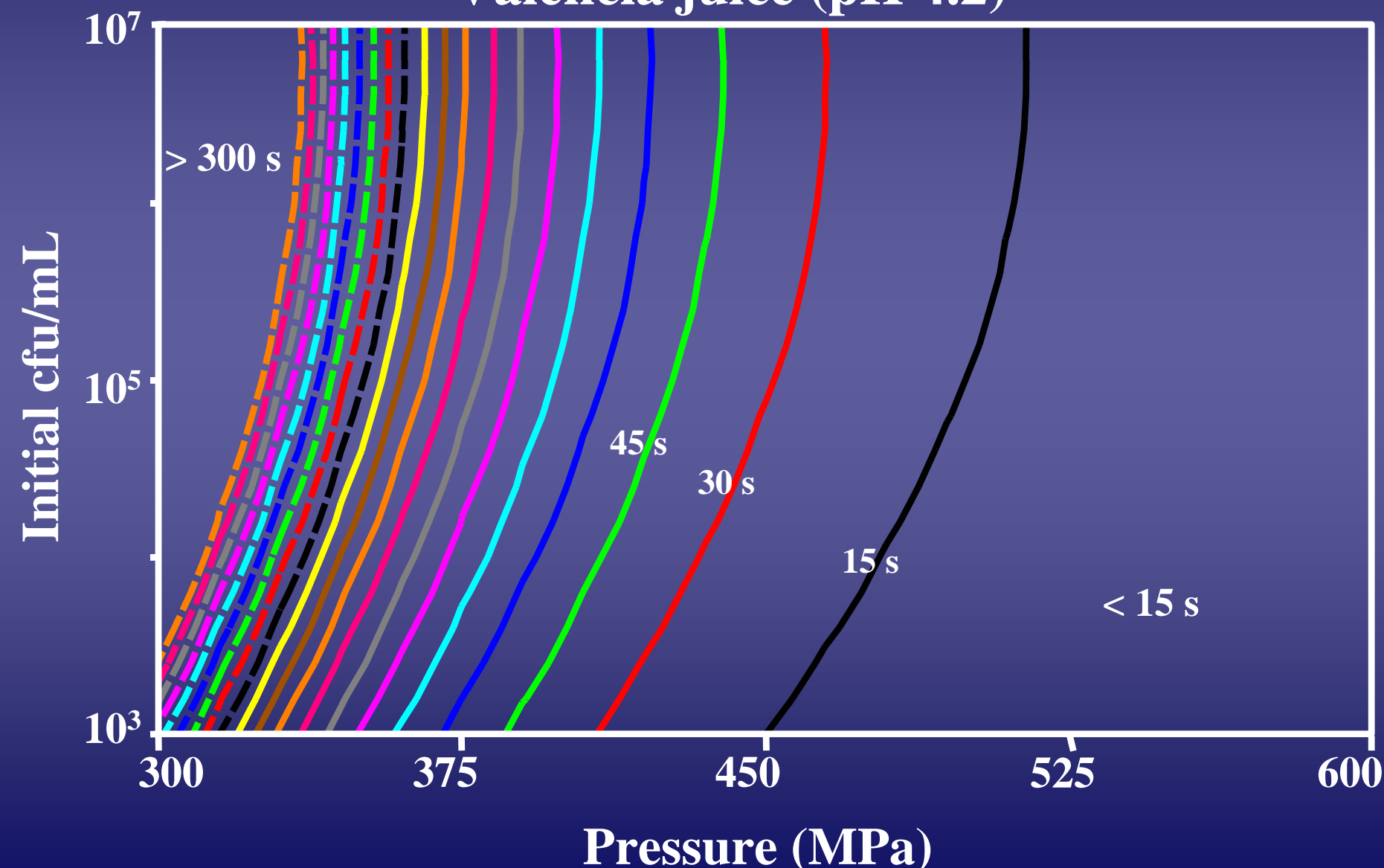


400 MPa  
for 10 mins



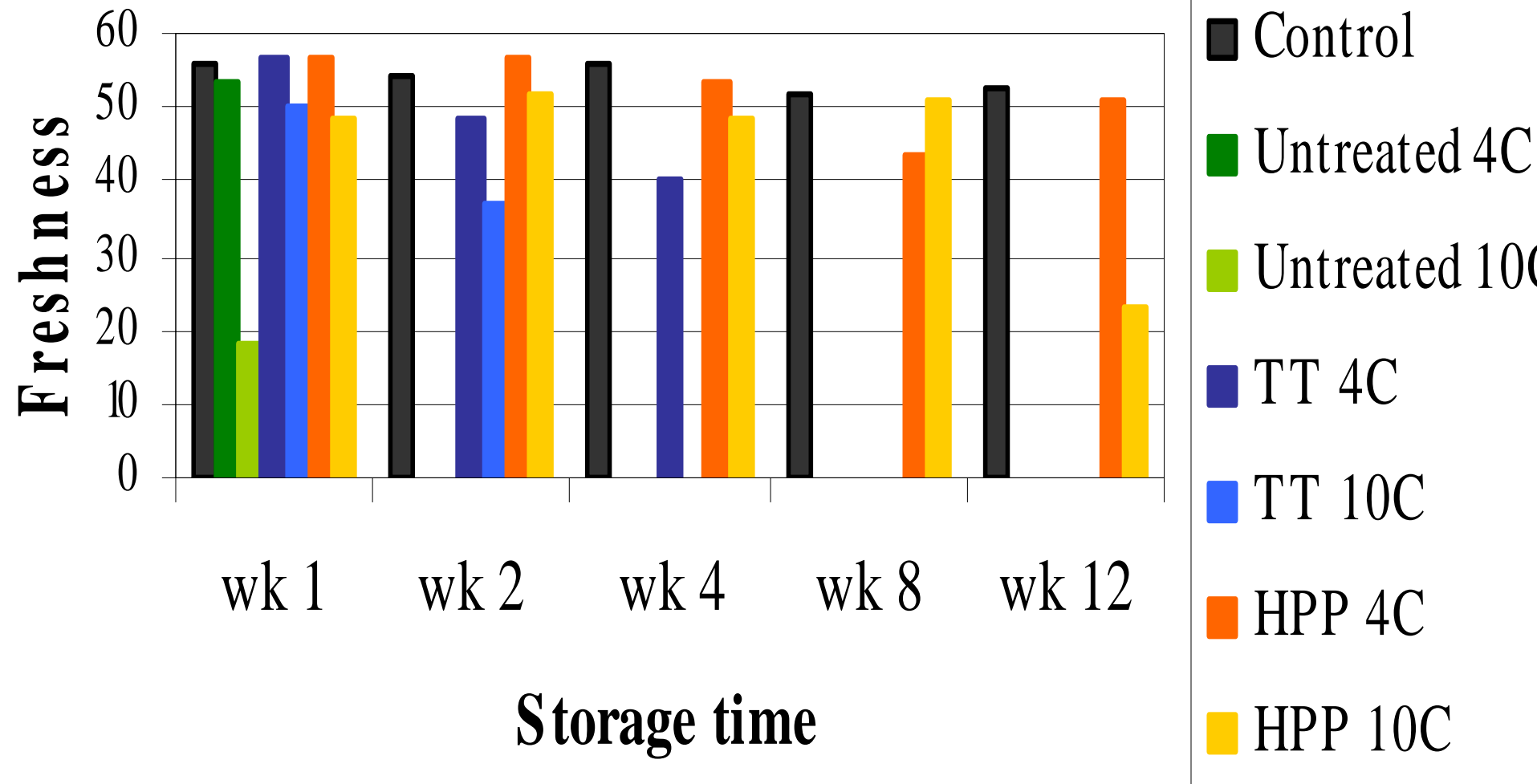
# Model for HPP Inactivation of *Salmonella*

Valencia juice (pH 4.2)



# Juice Consumer Perception of "Freshness"

Valencia



# Product Example

- Fruit Smoothie



**fruitmost™**

**FRUIT  
TO THE UTMOST.**

here's  
where to find out  
about the  
**fruit smoothie**  
that's gonna  
change the world  
of fruit smoothies.  
forever.

**blend**  
click here  
to learn more  
about the utmost in  
**limeade**  
refreshment.

**pure** our  
pure juices  
are purely  
and simply  
the best.  
(click)

© fruitmost 2004



# Product Examples: Processed Meat

## Key Drivers

Current shelf-life  
Limited & desire for 'Clean-  
Label'

Food Safety Concern  
Fermented Products *E.coli*  
Chilled products, *Listeria*



## Outputs & Outcome

Extended shelf-life  
New and existing markets

Enhanced Safety  
'Cold Pasteurisation'

## Research Challenges

Validation of Bacterial kill step  
Shelf-life & Sensory Studies



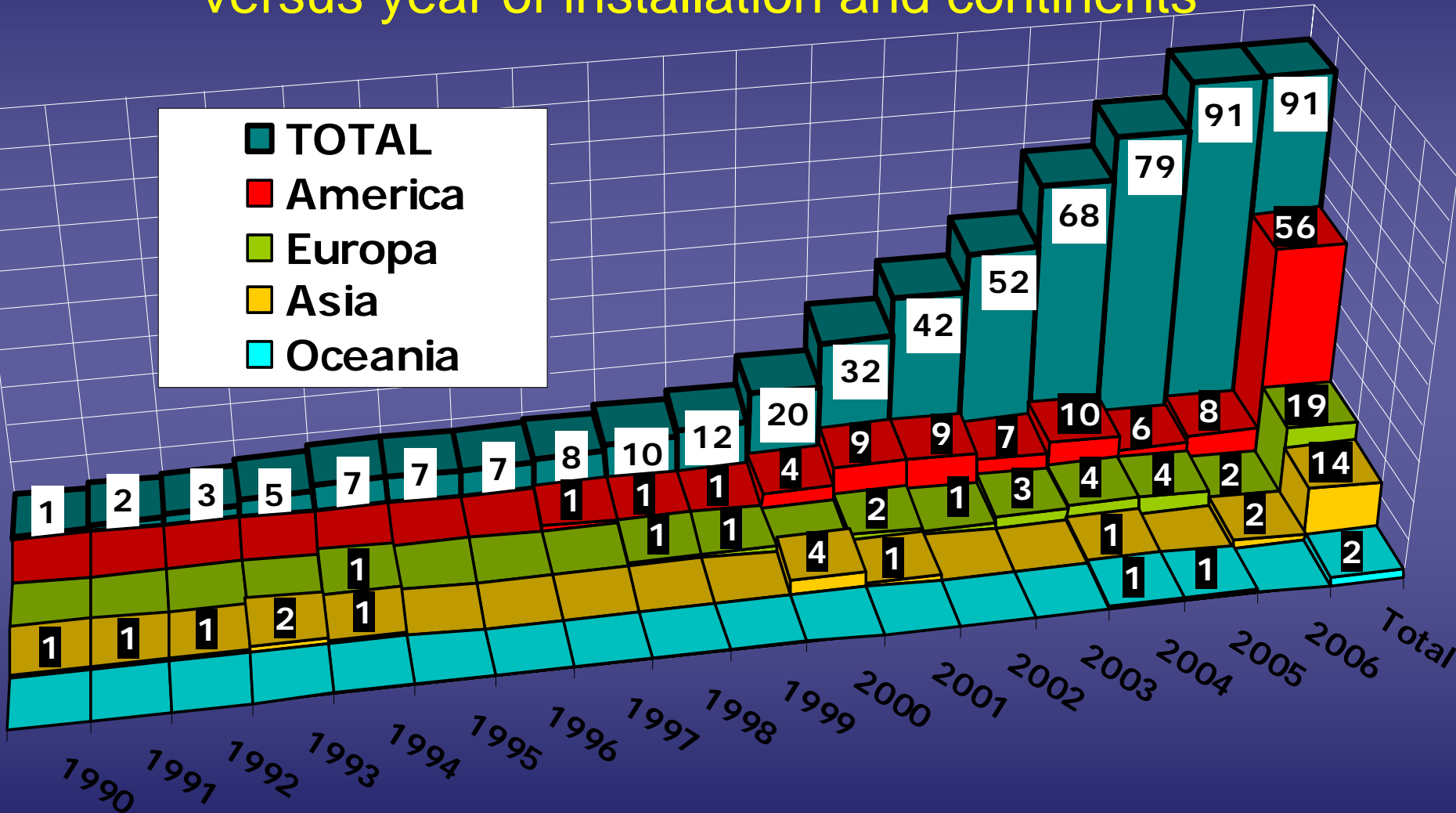
# – Product Example

## *Sliced Meats High Pressure Processing*





# Industrial HPP equipments number versus year of installation and continents



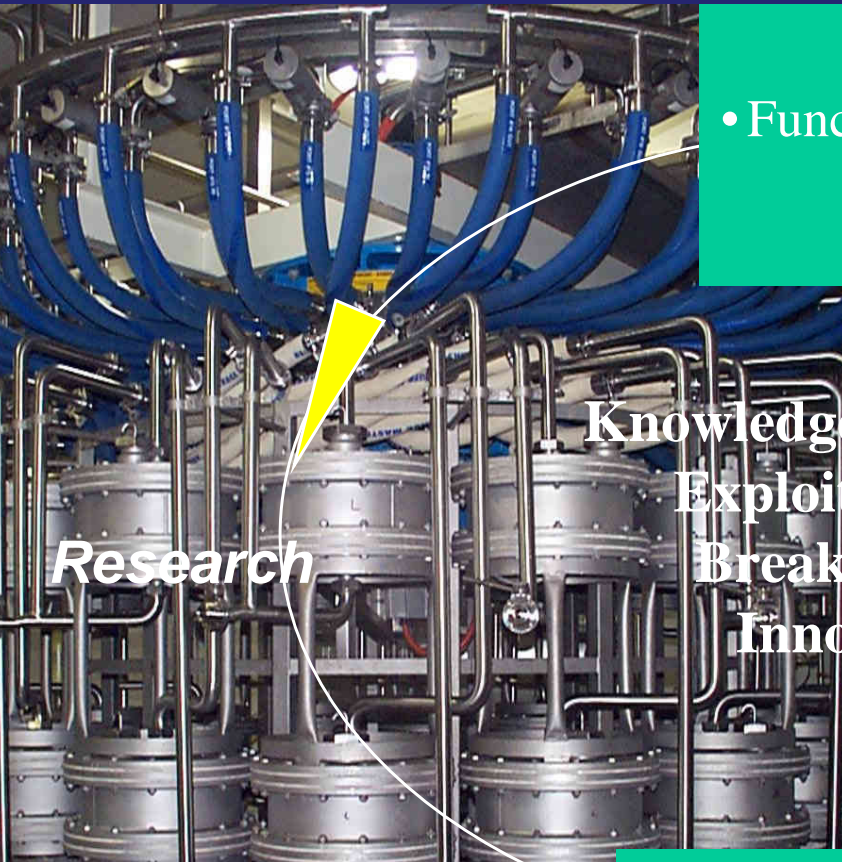
✓ 91 HPP machines in 55 companies producing more than 150 different products

✓ Total production in 2005 : 100 000 to 120 000 Tons





# Continuous Separation Technology



Research

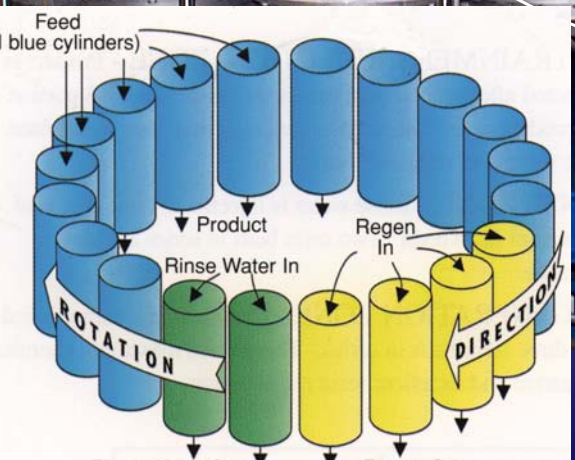
**Needs**

- Functional health foods

Knowledge Creation & Exploitation for Breakthrough Innovation

**Possibilities**

Novel separation technologies  
New functional ingredients



# Encapsulation Technology

## Needs

- Functional health foods

Knowledge Creation & Exploitation for Breakthrough Innovation

Research

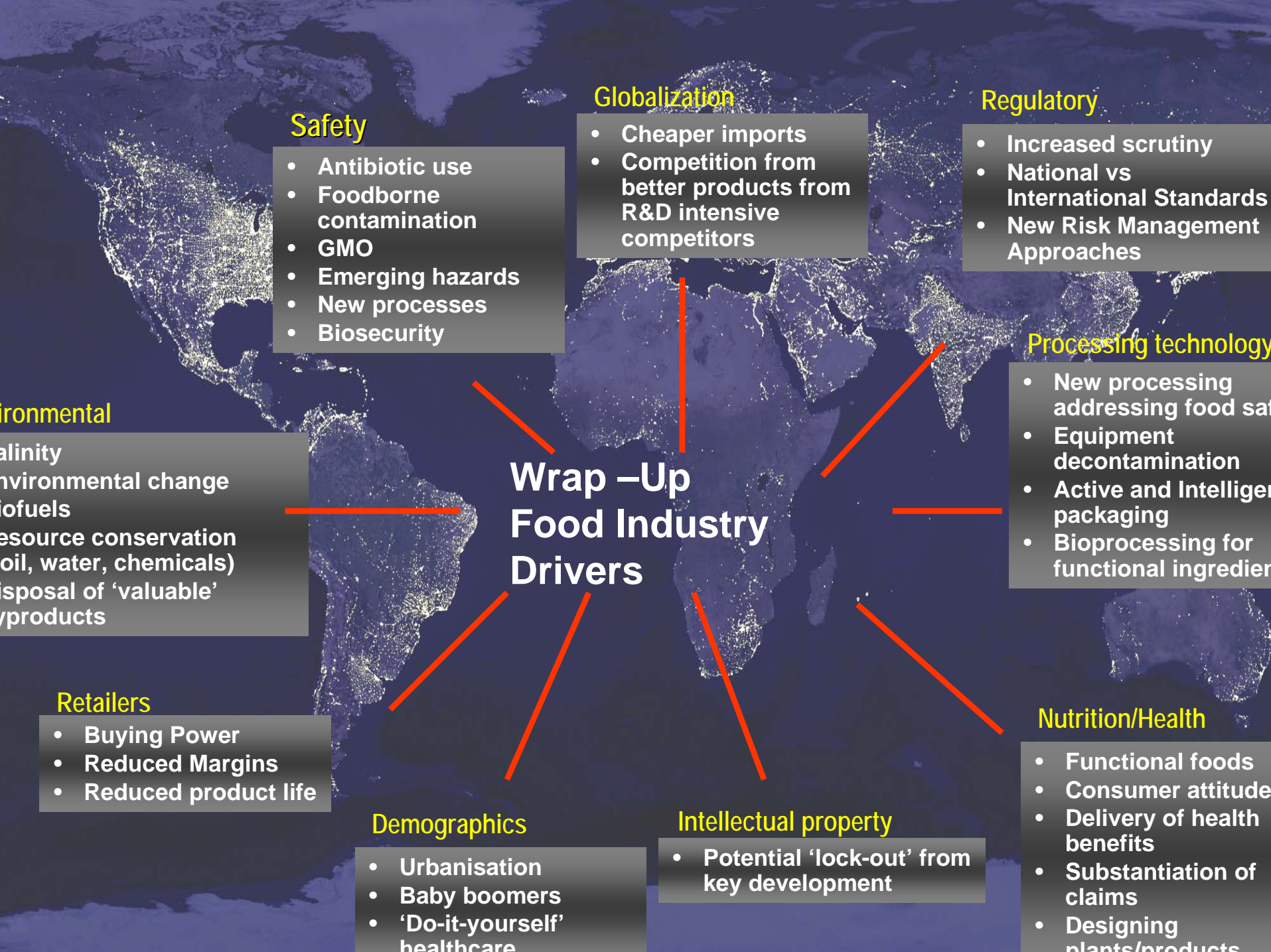
## Possibilities

- Tasteless & odourless omega 3
- Protection of sensitive ingredients



1565A DRIPHORM-50 14020





### Safety

- Antibiotic use
- Foodborne contamination
- GMO
- Emerging hazards
- New processes
- Biosecurity

### Globalization

- Cheaper imports
- Competition from better products from R&D intensive competitors

### Regulatory

- Increased scrutiny
- National vs International Standards
- New Risk Management Approaches

### Processing technology

- New processing addressing food safety
- Equipment decontamination
- Active and Intelligent packaging
- Bioprocessing for functional ingredients

## Wrap -Up Food Industry Drivers

### Nutrition/Health

- Functional foods
- Consumer attitude
- Delivery of health benefits
- Substantiation of claims
- Designing plants/products

### Intellectual property

- Potential 'lock-out' from key development

### Demographics

- Urbanisation
- Baby boomers
- 'Do-it-yourself' healthcare

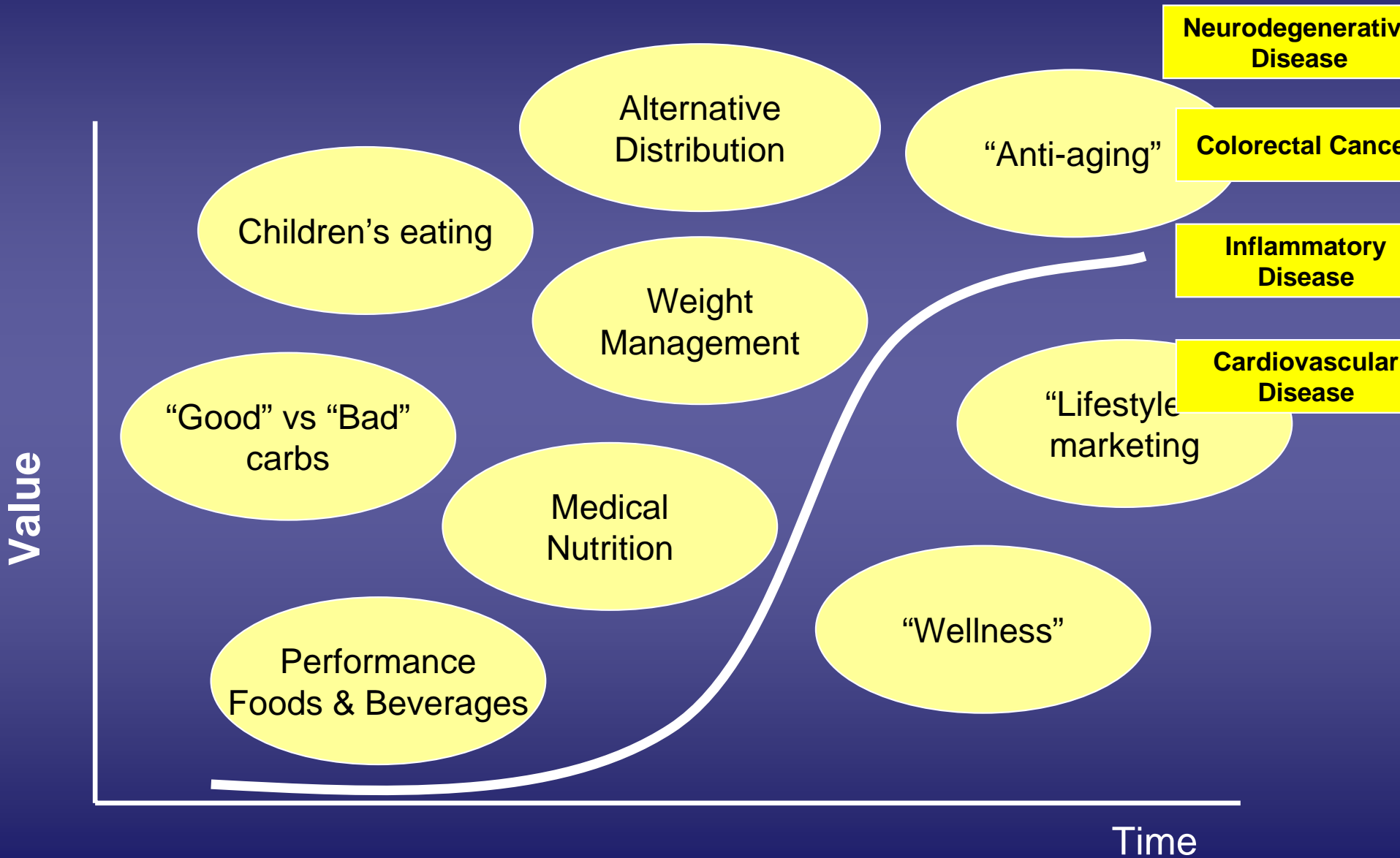
### Retailers

- Buying Power
- Reduced Margins
- Reduced product life

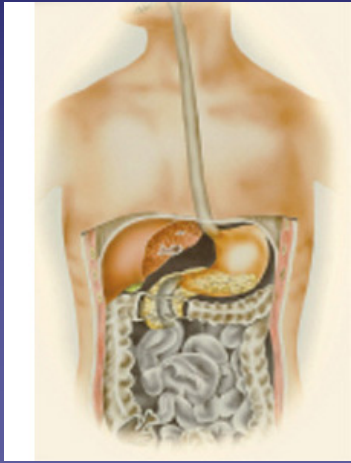
### Environmental

- Sustainability
- Environmental change
- Biofuels
- Resource conservation (oil, water, chemicals)
- Disposal of 'valuable' byproducts

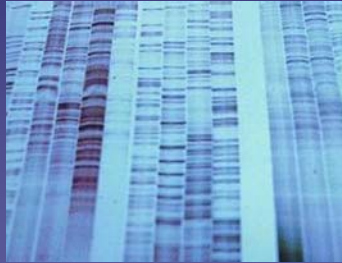
# “Second Generation” Drivers?



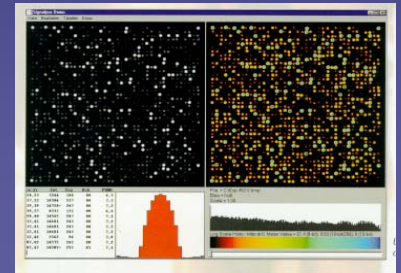
# The 'Omics' revolution and Health Promoting Foods



*Genomics*



*Transcriptomics*



Health Maintenance



Disease Development

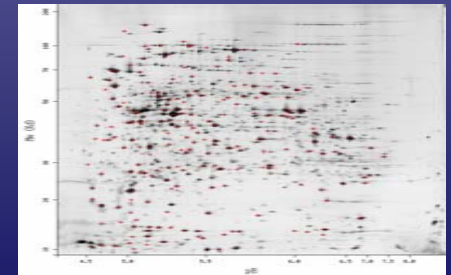
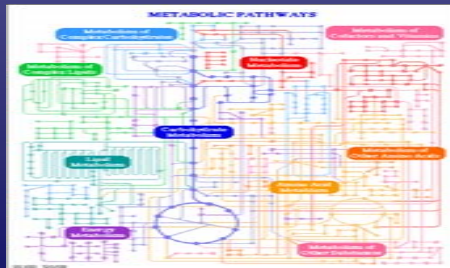


Food



*Proteomics*

*Metabolomics*



# Wrap-Up

- Innovation single most important issue for competitive advantage.
- However, innovation levels are decreasing and industry executives are unhappy with the return on their investments in NPD.
- Collaboration in ‘front-end’ and use external sources of innovation needed to reduce investment exposure and improve chances of achieving higher returns.
- Trend convergence is expected to continue, with “health” remaining the most important trend in the global food and drinks market.
- Technologies offer exciting possibilities to deliver against these consumer trends
- Illinois well placed to take a leadership position, policy/strategy needed to identify and use synergies within state