

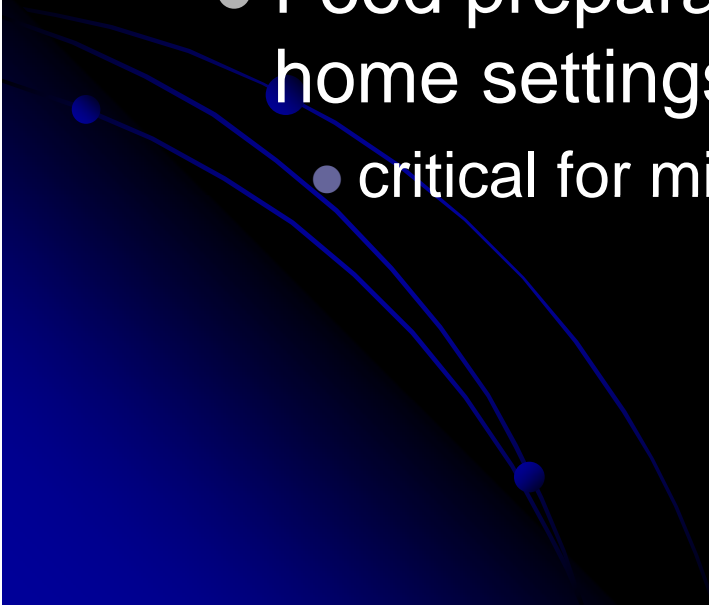
Microbiological Risk Management: Indian Experience



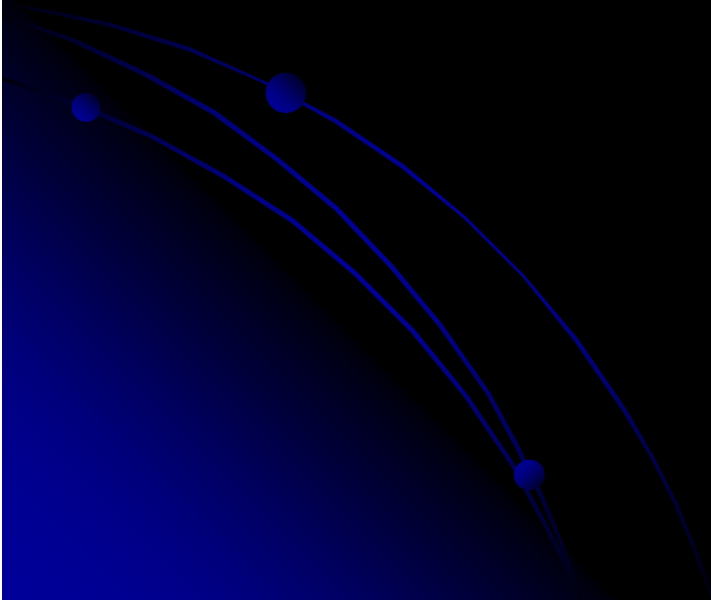
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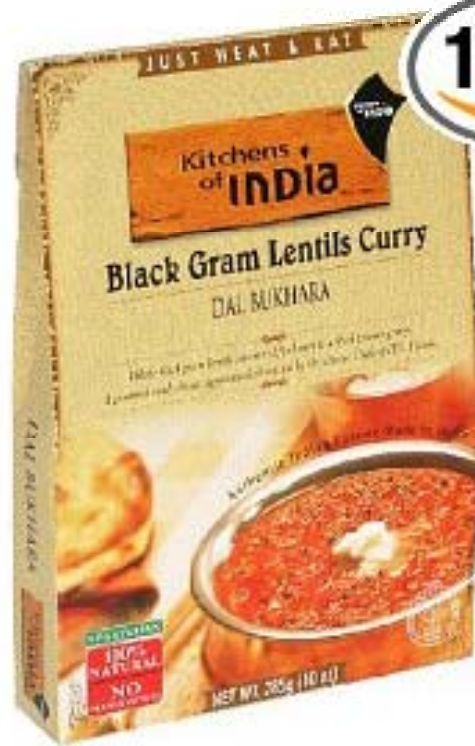
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Facts

- Burden of Infectious diseases is high
 - Environment sanitation and hygiene
 - principal contributors
 - Food preparation / storage and handling in home settings
 - critical for microbiological safety
- 

The Food Landscape of India















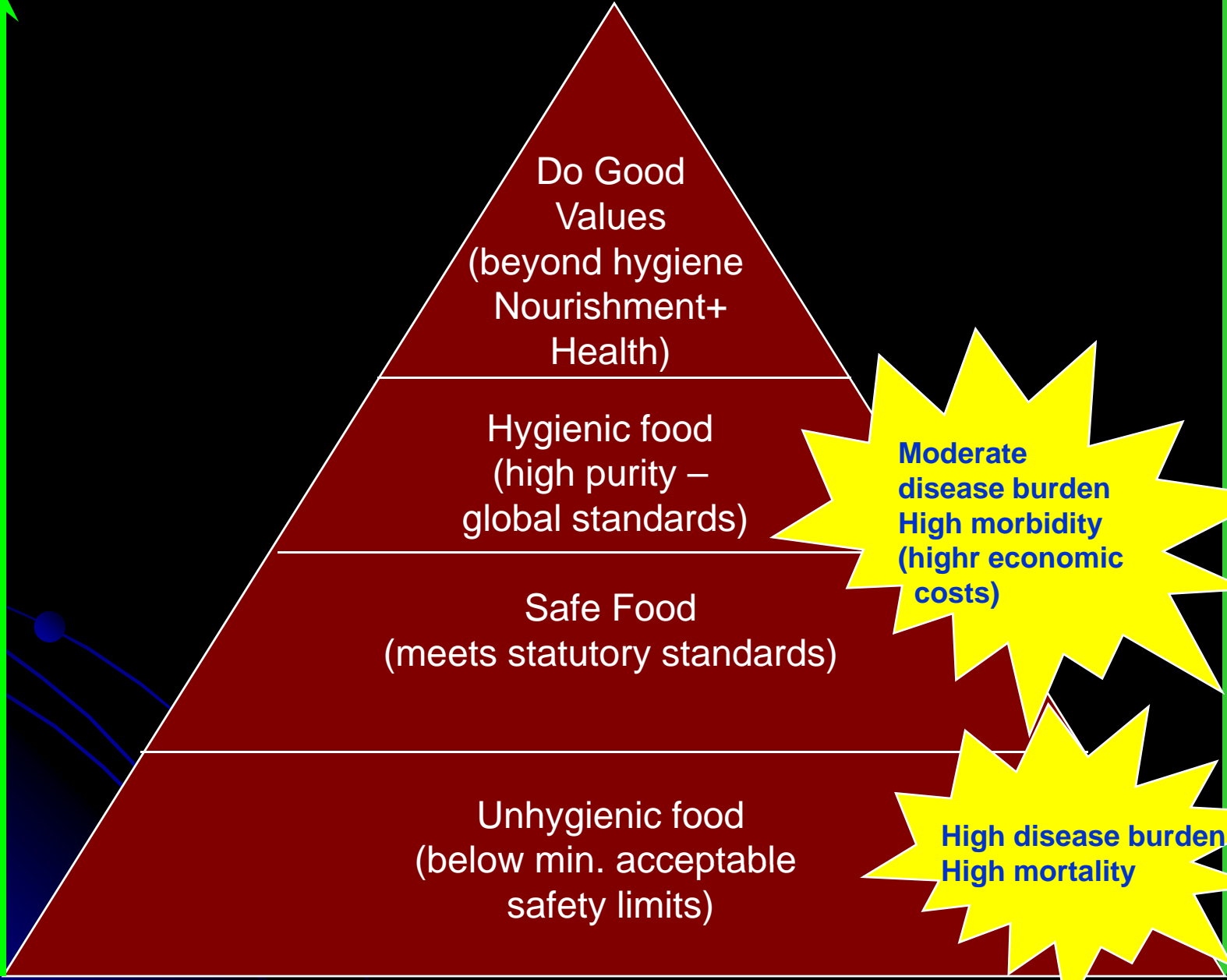
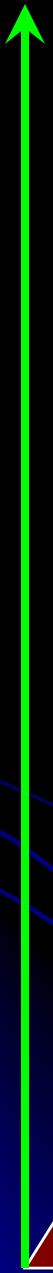


Increased out of home meal and snacking

- Processed foods
 - Enhanced proportion in meals
- Diversity of options
 - Traditional / Ethnic
 - Western & Eastern

**Complex & Challenging
Food Safety Environment**

Food value



Do Good Values
(beyond hygiene
Nourishment+
Health)

Hygienic food
(high purity –
global standards)

Safe Food
(meets statutory standards)

Unhygienic food
(below min. acceptable
safety limits)

Moderate
disease burden
High morbidity
(high economic
costs)

High disease burden
High mortality

Population Exposure



Food value

Population Exposure

Do Good Values
(beyond hygiene
Nourishment+
Health)

Hygienic food
(high purity)

Given our preferences almost
entire strata of society can
potentially have exposure to
unhygienic food

Moderate
disease burden
High morbidity
(high economic
costs)

Unhygienic food
(below min. acceptable
safety limits)

High disease burden
High mortality

Changes in food markets with processes of economic development:

	Low Income	High Income
Role of food markets	Own production a major source of food supply. Markets may be a relatively minor source of food, particularly in rural areas.	Own production an insignificant source of food supply. Virtually all food obtained through market
Food Processing Sector	Informal sector consisting of small-scale operations that are not legally-registered predominates	Formal sector consisting of legally-registered enterprises predominates
Branding	Non-branded food products predominate	Branded food products predominate
Food preparation	Most food preparation undertaken within the households	Significant proportion of food preparation undertaken outside the household by food processors and/or the food service sector
Food Retailing	Small informal retailers predominate	Large retail chains predominate
New food products	Low rates of entry of new food products	High rates of entry of new food products
Geographical distribution	Local food distribution networks predominate	Wide food distribution networks encompassing both national and international sources of supply
Consumer demand	Income and prices are main factors influencing consumer demand	Perceived food safety and quality have major influence on consumer demand


Indian Food Market: Major Trends

- Total Indian food market US\$ 69.4 Billion
- Value-added food products is US\$ 22.2 billion
- Domestic market has > 1,000 million consumers
- 300 million upper & middle class consumers
- 200 million more consumers expected to shift to processed food by 2010
- 50% of household expenditure is on food items
- Rise in overall imports - 24.43%
- Rise in overall exports - 22.48%

Source: Food & Beverage News, Ministry of External Affairs and Central Statistical Organization, Govt. of India

Microbiological Risks - India

Critical Areas

- Scale-up of traditional foods
 - Imports/ production, distribution and service of foods
 - Exports
- 

Traditional foods

- Mass produced branded foods
 - Examples
 - Retort packed RTE meals
 - Canned sweets – *Rasgollas*/ dairy based
 - Dry savories
 - Many more
- Low-medium scale unbranded/ local/ retail/ service
 - Mithai shops (standalone/ chains)
 - Chaats
 - Packaged fresh prepared foods in retail
 - E.g. *idlis*/ *dhoklas*
 - *Confounding factor*
 - Increased demand of western confections e.g. pastries

Unbranded/ local Foods

Mithais as an example

- Milk derived ingredients / cereal / gluten / sugar
 - Depend on heat, low moisture and high sugar / fat as key hurdles for microbiological safety
 - Increased microbiological risks on account of
 - Scale-up and distribution
 - Increasing share of sugar-free sweets

Challenges in Logistics

- Cold chain inefficiencies

- Transport

- Retail

- Storage

- Display

- Freeze-thaw and power outages

- Cross-contamination of raw and RTE/ RTS foods during distribution

Exports

Rising in Volumes / Variety/ Geographies

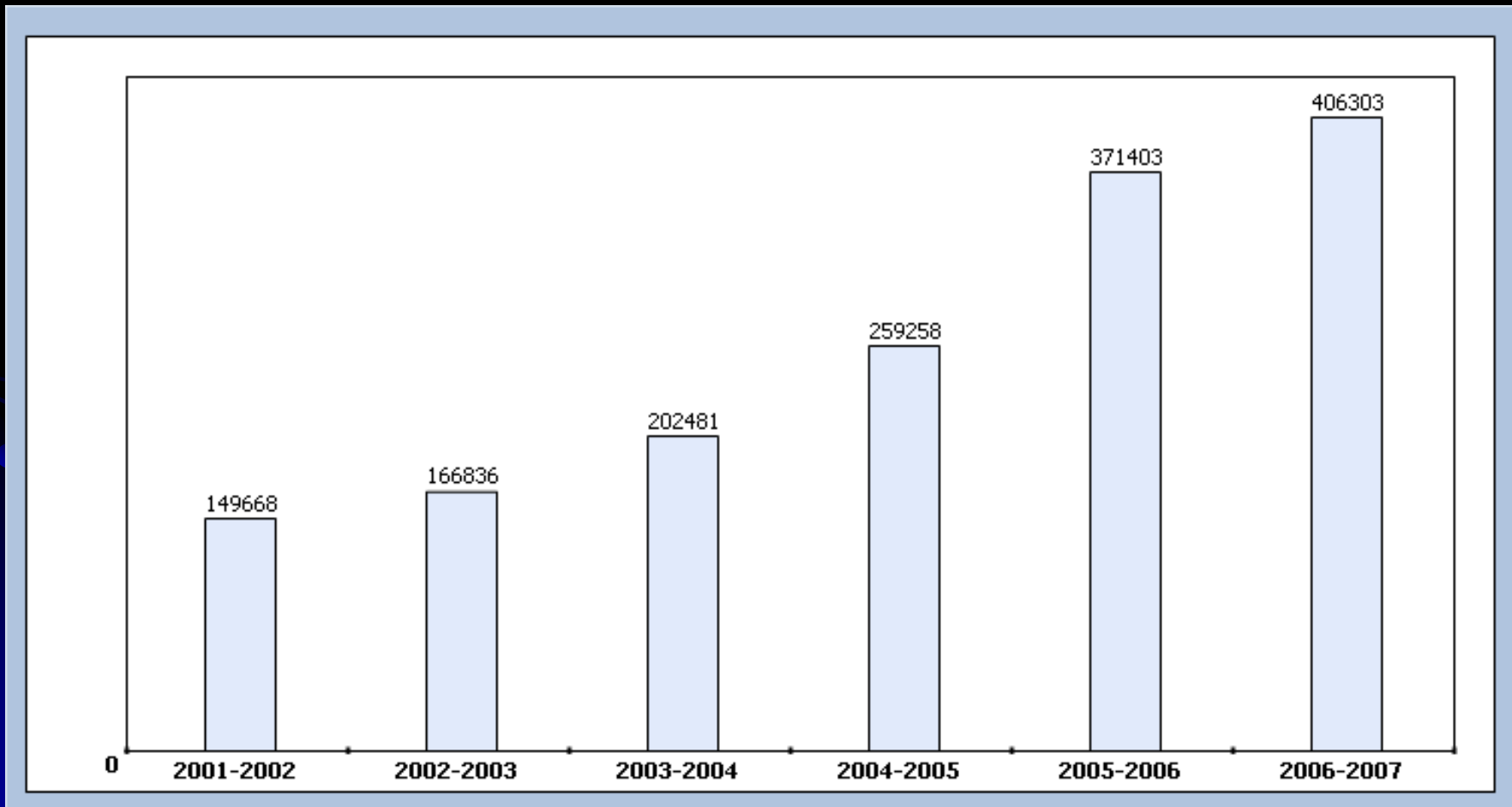
- Good governance and Industry initiatives
- Facilitation role by organizations
 - APEDA
 - MPEDA
 - EXIM Bank

Need to be technically agile

- Emerging pathogens / risks
- Capabilities and capacity for meeting sudden issues

India export statistics Animal Products

- Source: DGCIS Annual export



Imports

- Consumer awareness
 - Foods designed for a certain consumption pattern
 - Indian consumers use in their context
 - Product intended for single use split for multi-use
 - Introduction of microbial risks?

Risk Assessment: Additional Areas

- What data exists on
 - Epidemiology (quantified disease burden of food borne diseases)
 - Pathogen (what types and what characteristic)
 - Antibiotic resistance
 - Infectious dose
 - Are emerging pathogens a threat?
 - *E. coli* 0157
 - *Listeria* spp.
 - Viral infections
 - UK - viruses account for ~48% of all infectious intestinal diseases.

Microbiological Safety of Foods

- **TRADITIONAL FOODS**

- Increased microbiological risks on account of
 - Scale-up and distribution
 - Increasing share of sugar-free sweets

- **LOGISTICS**

- Freeze-thaw and power outages
- Cross-contamination of raw and RTE/ RTS foods during distribution

- **EXPORTS - Need to be technically agile**

- Emerging pathogens / risks
- Capabilities and capacity for meeting sudden issues

- **IMPORTS**

- Product intended for single use split for multi-use
 - Introduction of microbial risks?

Microbiological Safety of Foods

Focus Areas:

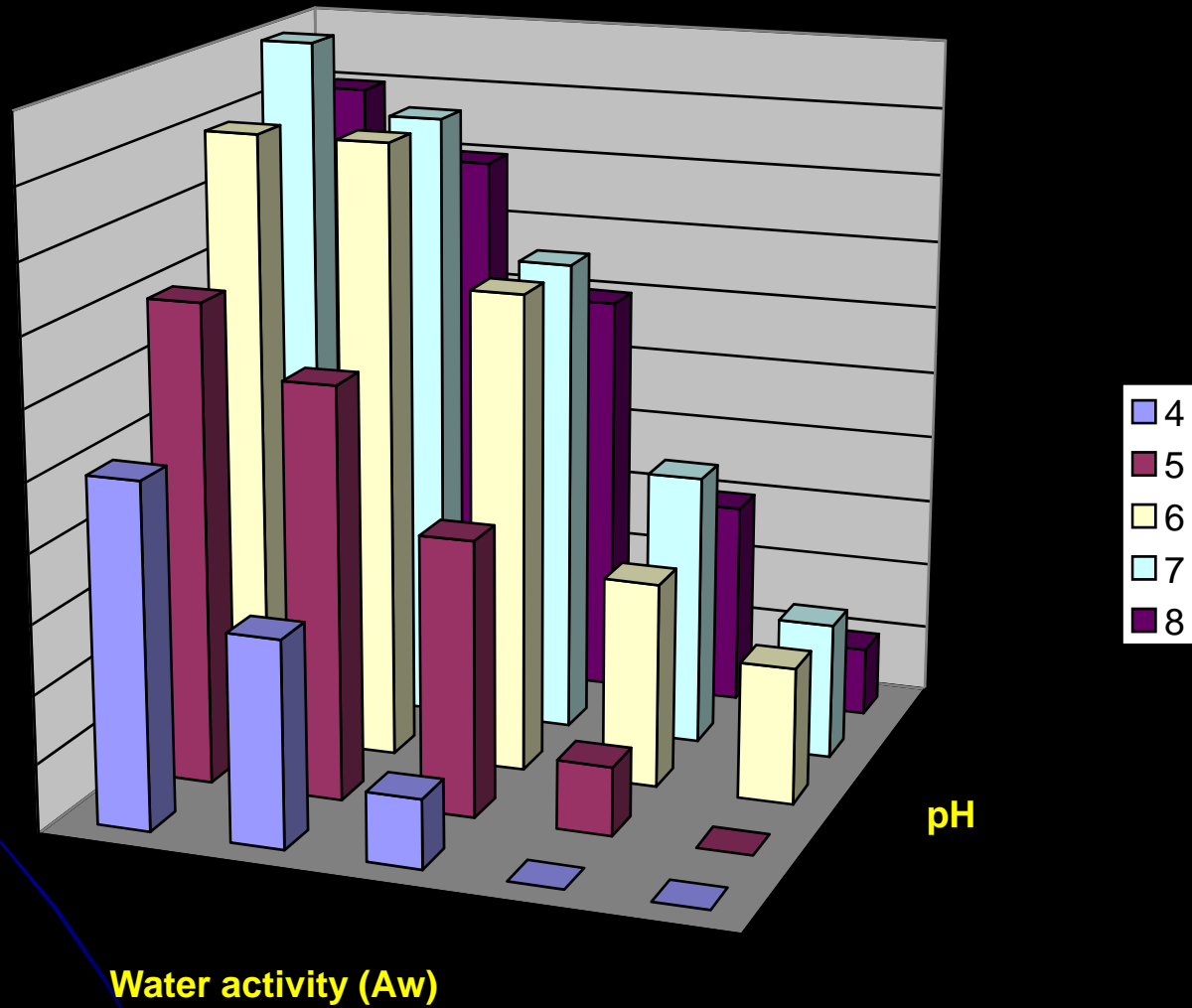
- **Traditional Foods**
 - Food-pathogen' relationships for 'Indian' foods
 - Understand their growth / survival / toxin production
- **Logistics**
 - Assess microbiological risks 'creeping' in distribution, storage, handling (service)
 - Develop infrastructure
 - Hygiene training & management
- **International Trade**
 - Rising animal exports
 - Higher probability of microbiological issues
- **Emerging food categories**
 - Poultry
- **National Food Safety Priority**
 - Strengthen epidemiology and surveillance in context of Food & water borne diseases

MRA & Indian Traditional Foods

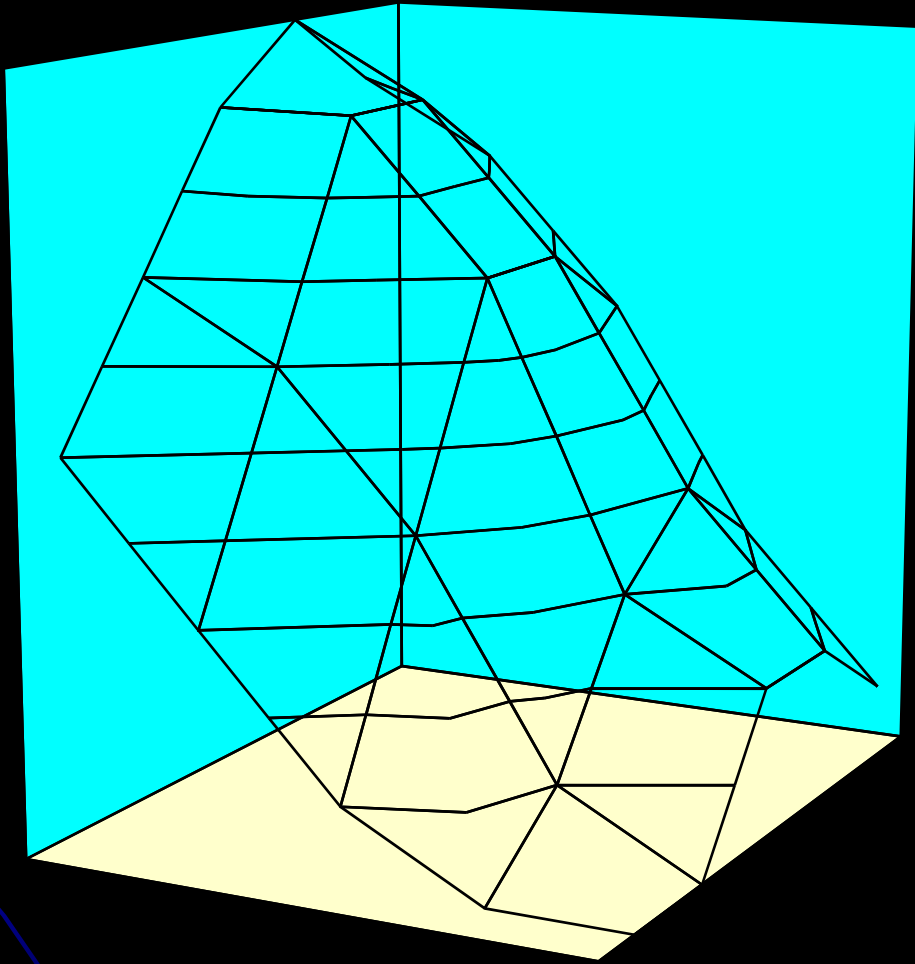
- **Predictive models**
 - **Primary – organisms of concern**
 - **Secondary & tertiary in the context of the formulation**
- **Microbial response to a particular substrate / environmental condition**
- **Mathematical models**
 - **The models use experimental data, and equations to produce a prediction**
 - **Use the prediction as a guide to the response of an organism to a particular set of conditions**

Effect of pH+a_w on growth of *S. aureus*

S. aureus
Key risk in
milk-based
sweets?

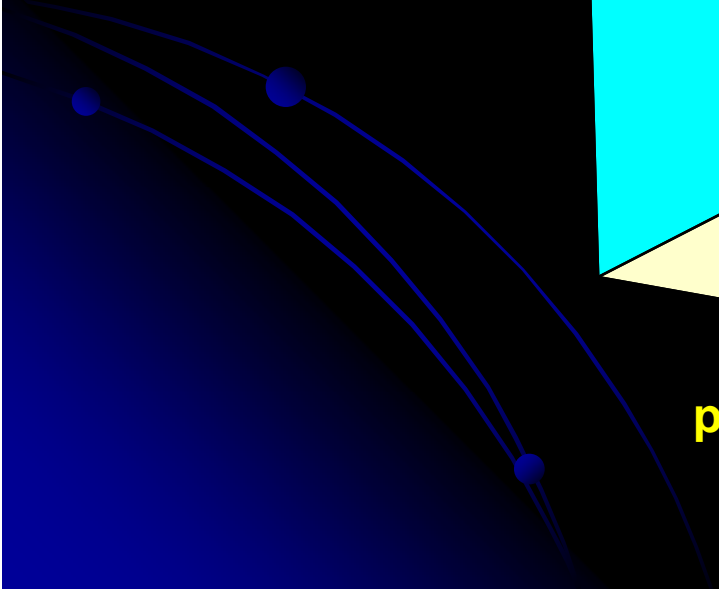


Effect of pH & Water activity on growth rate of *S. aureus*



pH

water activity



Environment
Temperature (C)

pH

NaCl(%)

Aw

Factor4:

Initial logc.

Phys. state

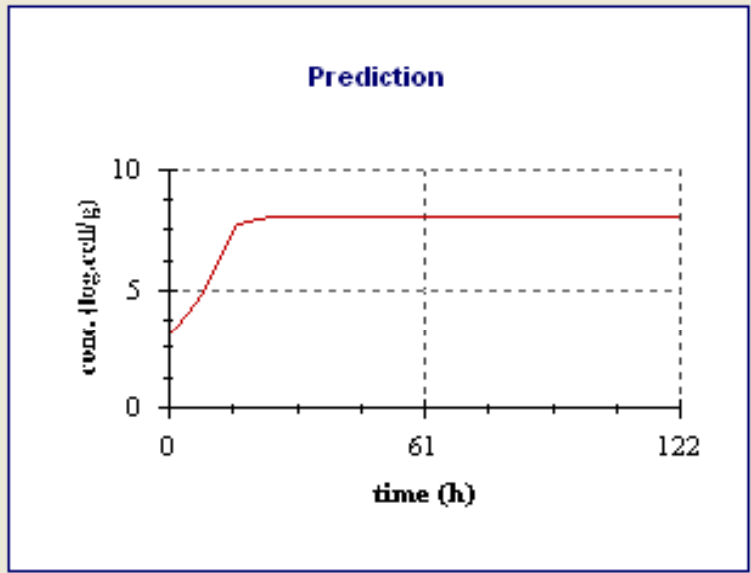
Obs.time (h)

For default values, leave these boxes empty

Staphylococcus aureus

In broth

time(h)	conc.(log cells/g)
0.00	3.00
8.13	4.89
16.27	7.75
24.40	8.09
32.53	8.09
40.67	8.09
48.80	8.09
56.93	8.09
65.07	8.09
73.20	8.09



Max.rate (log conc/h)

0.3975

Doubling time (h)

0.76

Model region

	Temp (C)	pH	Aw
min	7.5	4.3	0.907
max	30	7.1	1

Predict

Exit

Zoom In

Help

Growth model: Baranyi, J. and Roberts, T. A. (1994): A dynamic approach to predicting bacterial growth in food. International Journal

Growth Predictor

Environment
Temperature (C)

pH

NaCl(%)

Aw

Factor4:

Initial logc.

Phys. state

Obs.time (h)

For default values, leave these boxes empty

Staphylococcus aureus

In broth

time(h)	conc.(log cells/g)
0.00	3.00
8.13	6.20
16.27	8.08
24.40	8.09
32.53	8.09
40.67	8.09
48.80	8.09
56.93	8.09
65.07	8.09
73.20	8.09

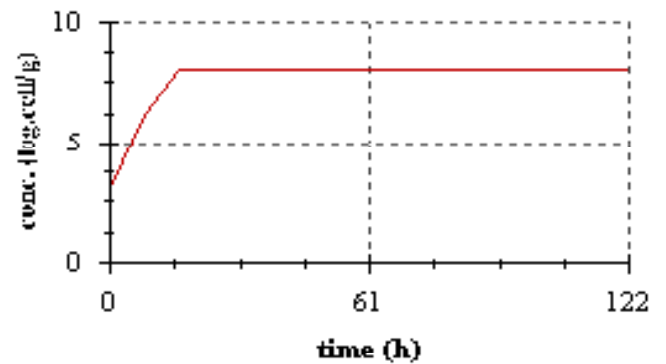
Max.rate (log conc/h)

0.5604

Doubling time (h)

0.54

Prediction



Model region

	Temp (C)	pH	Aw
min	7.5	4.3	0.907
max	30	7.1	1

Predict

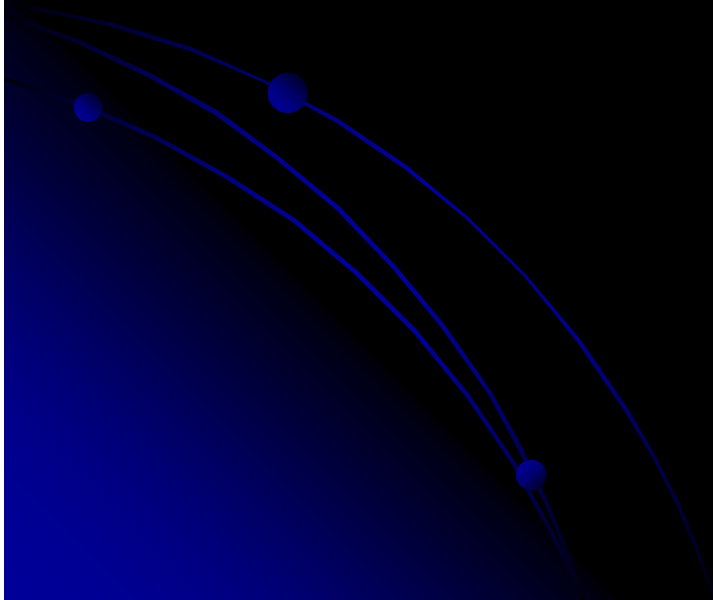
Exit

Zoom In

Help

Growth model: Baranyi, J. and Roberts, T. A. (1994): A dynamic approach to predicting bacterial growth in food. International Journal

Other Trends



Increasing Poultry Consumption

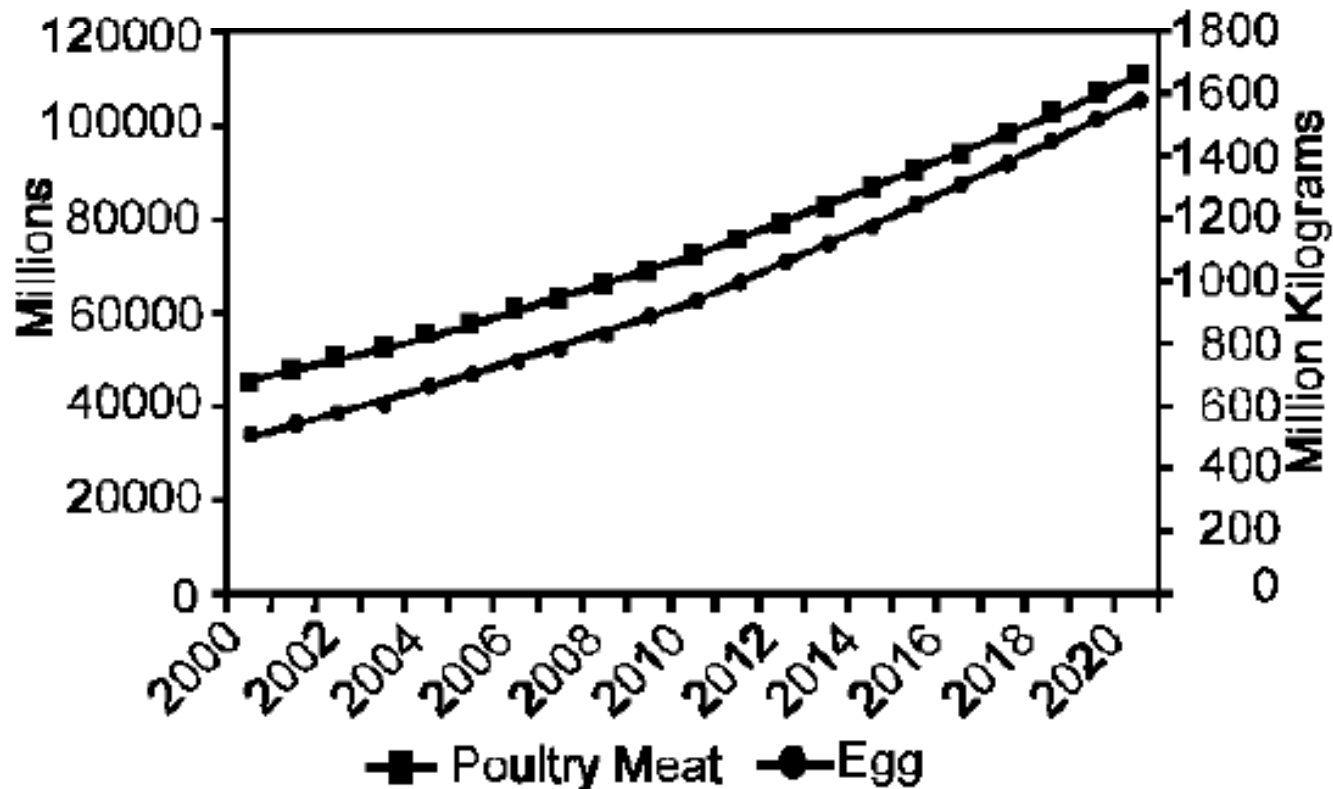
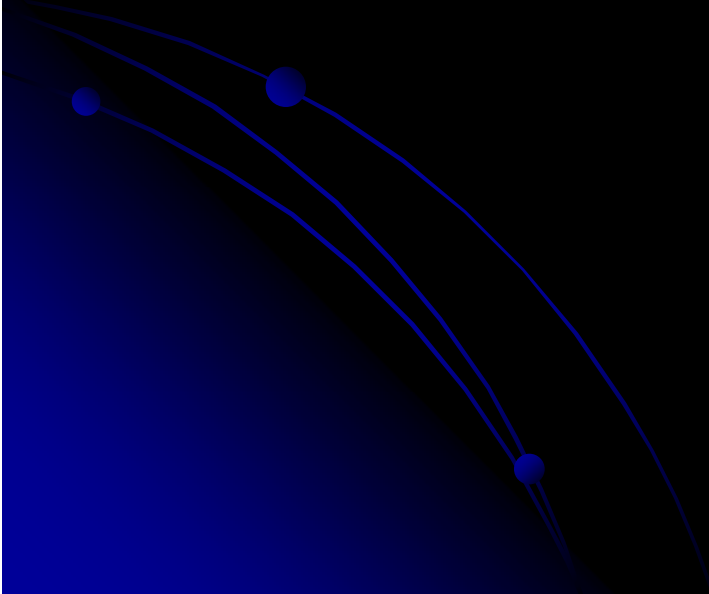


Fig. 5: Projected poultry meat and egg consumption

Table 3. Estimated incidence of food-borne salmonellosis in India:

Product	Minimum	Mean	Maximum
Poultry (Raw)	22,300	28,300	34,300
Eggs (Raw)	2,520,000	2,830,000	3,150,000
Beef (Raw)	273,000	405,000	535,000
Pork (Raw)	487,000	584,000	681,000
Milk & dairy products (Ready-to-eat)	0	241,000	561,000
Fish & seafood (Ready-to-eat)	0	1,410,000	3,520,000
Fruit & vegetables (Ready-to-eat)	0	12,600	50,500
TOTAL	3,300,000	5,510,000	8,530,000

Source: WHO.



New Environs of food consumption

- **Food Courts/ Malls**
 - In between mass scale & home scale
 - Time temp. critical
 - Raw & finished cross-contamination
 - Hygiene awareness & training
 - HACCP
- **Need to implement minimum standards**
 - Consider certification?

Table 1. Estimated occurrence of bacterial infections and intoxications in selected regions:

Disease	Africa	Central & South America	South East Asia	Western Pacific ¹
<i>Bacillus cereus</i> gastroenteritis	+++	+++	+++	+++
Botulism	+	+	+	+
Brucellosis	+ / ++	++	+ / ++	+ / ++
Campylobacteriosis	+++	+++	+++	+++
Cholera	+ / ++	+ / ++	+	+
<i>Clostridium perfringens</i> enteritis	+++	+++	+++	+++
<i>Escherichia coli</i> disease	+++	+++	+++	+++
Listeriosis	+	+	+	+
Typhoid and paratyphoid fever	++	++	++	++
Salmonellosis	+++	+++	+++	+++
Shigellosis	+++	+++	+++	+++
<i>Staphylococcus aureus</i> intoxication	+++	+++	+++	+++
<i>Vibrio parahaemolyticus</i> enteritis			++	++
<i>Vibrio vulnificus</i> septicaemia				++

Note: -: absent; +: occasional or rare; ++: Frequent; +++: Very frequent.

Source: WHO.

Key Concerns

- *Staphylococcus aureus* (toxigenic)



- *Salmonella* infections



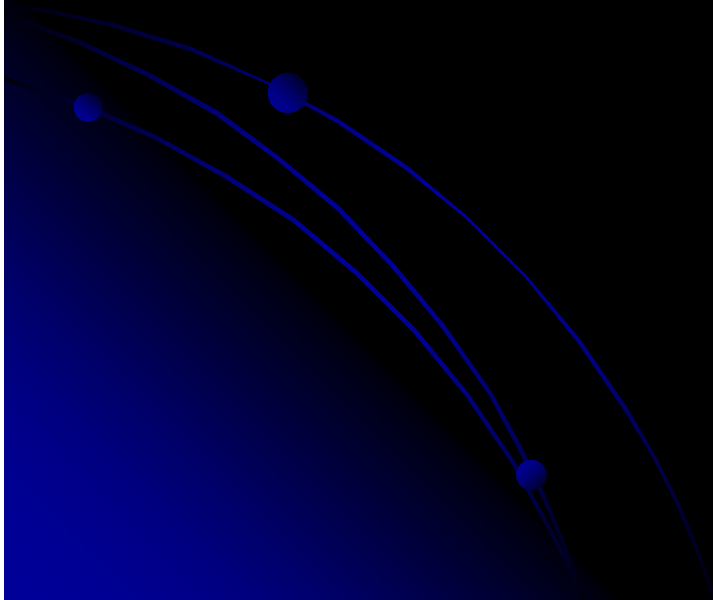
- *Bacillus cereus* (toxigenic) ?



- *Vibrio* spp. (typical/ atypical)

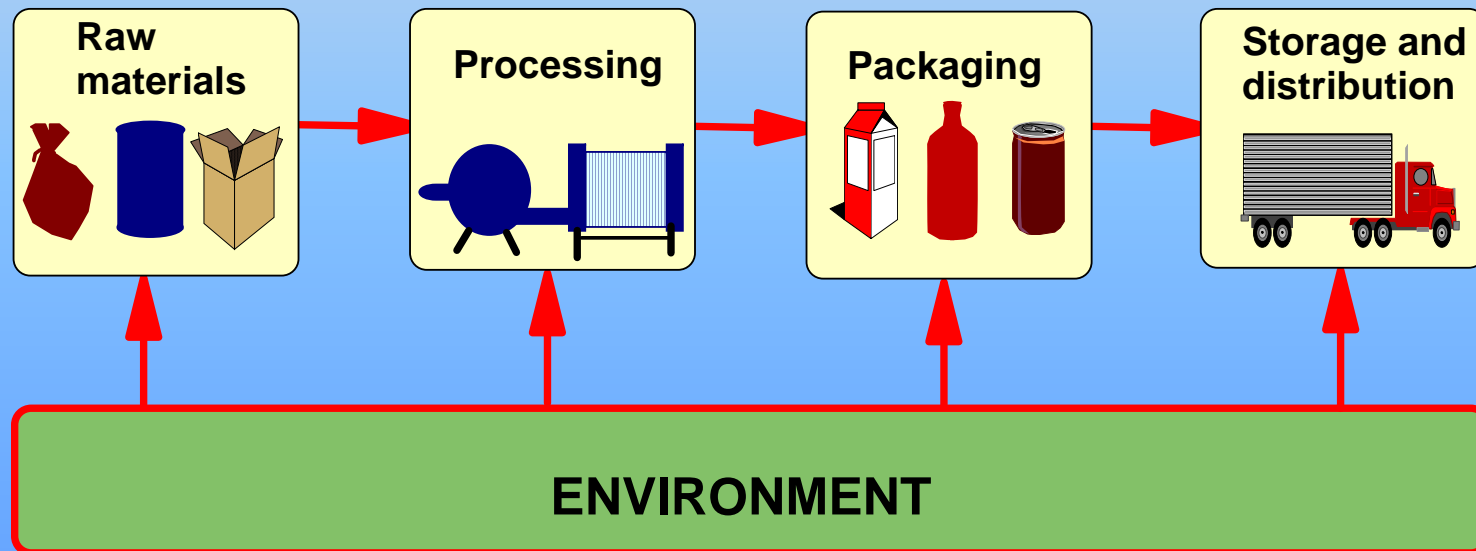


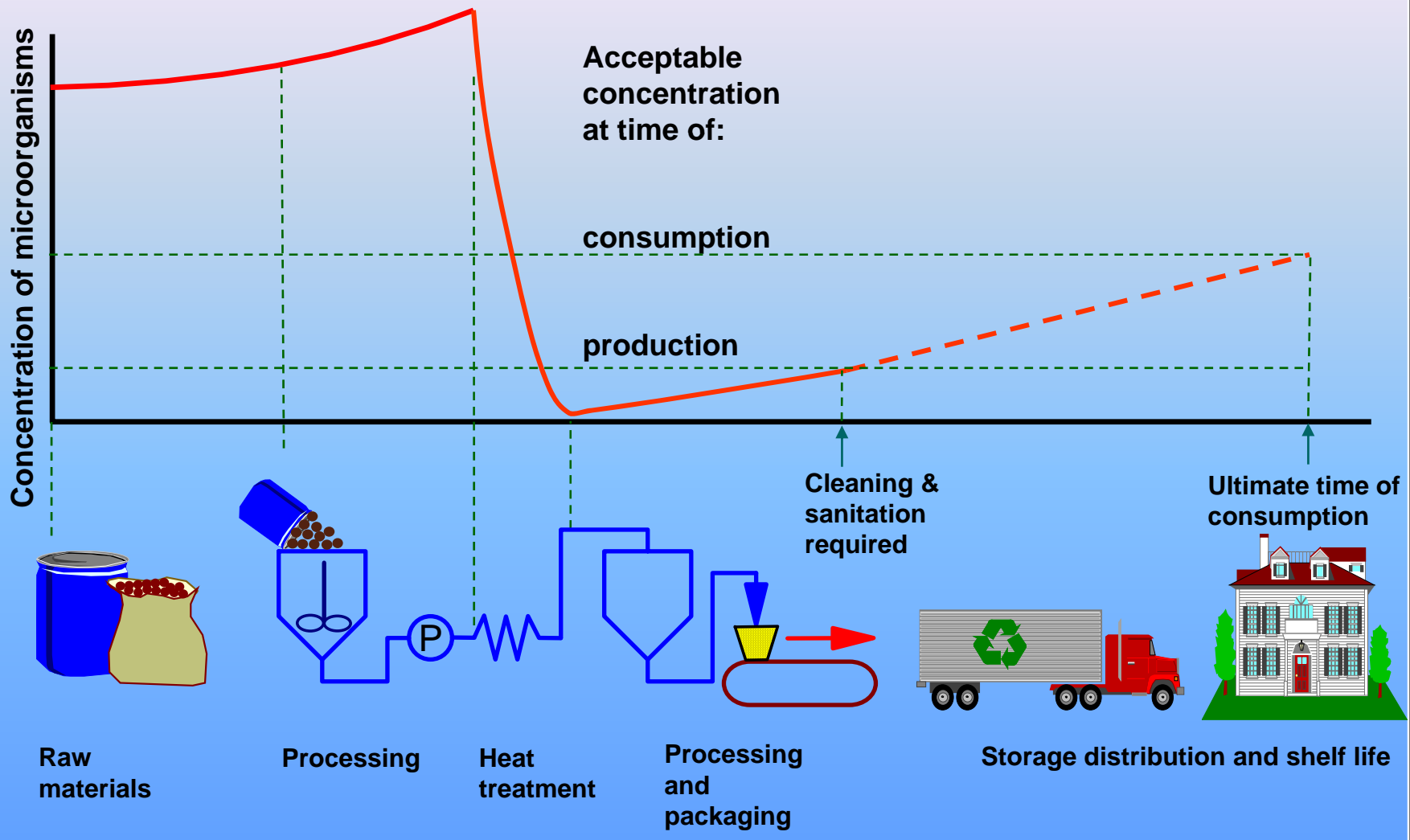
Industry Perspective



Sources of infection

- during processing & distribution





Food Safety In Unilever: A Risk Management Approach

**Product
Development**

Predictive
Modeling

**Process
Development**

**Production &
Distribution**

GMPs

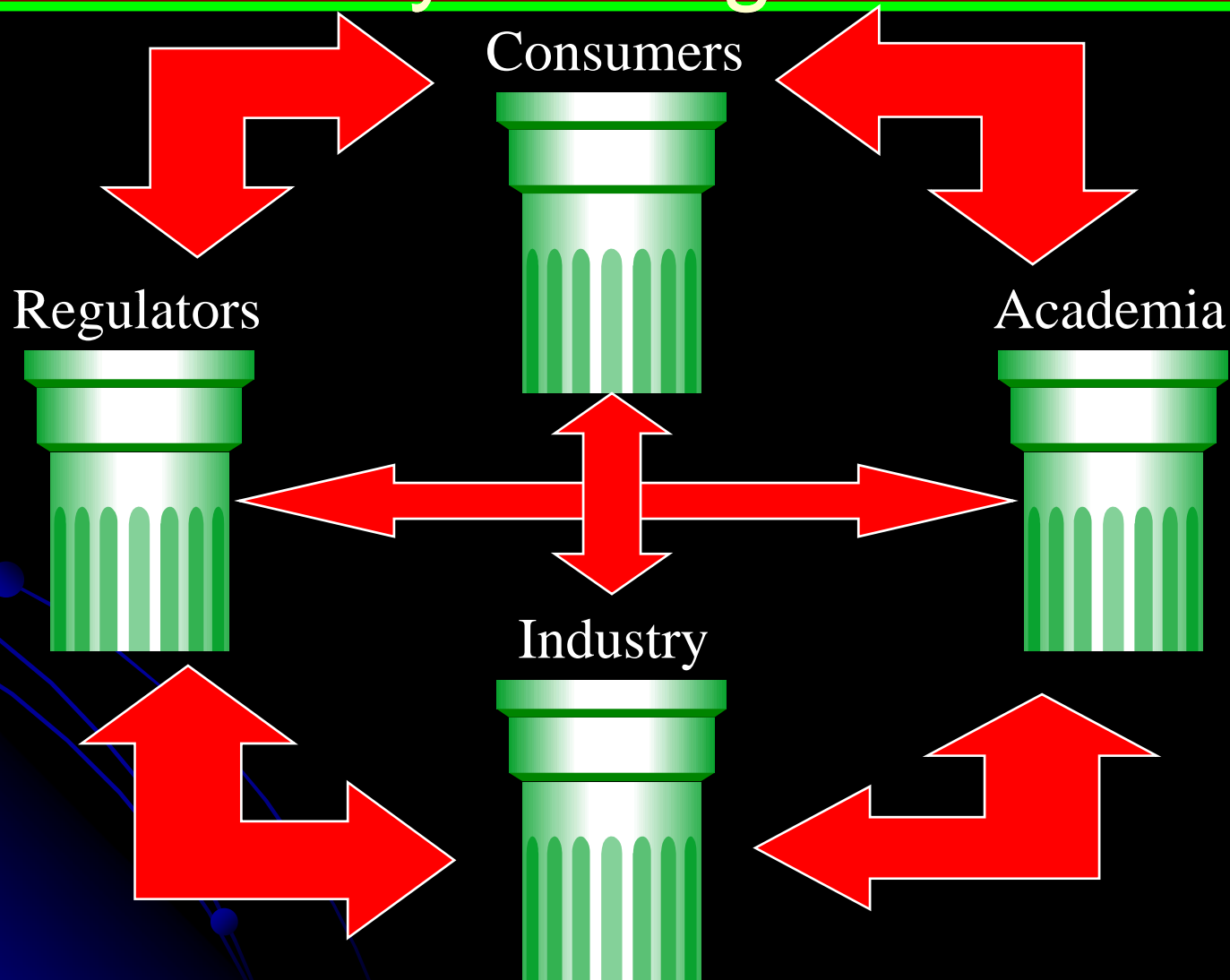
**Common science platforms
to deliver food safety across
foods portfolio global & local**

Development

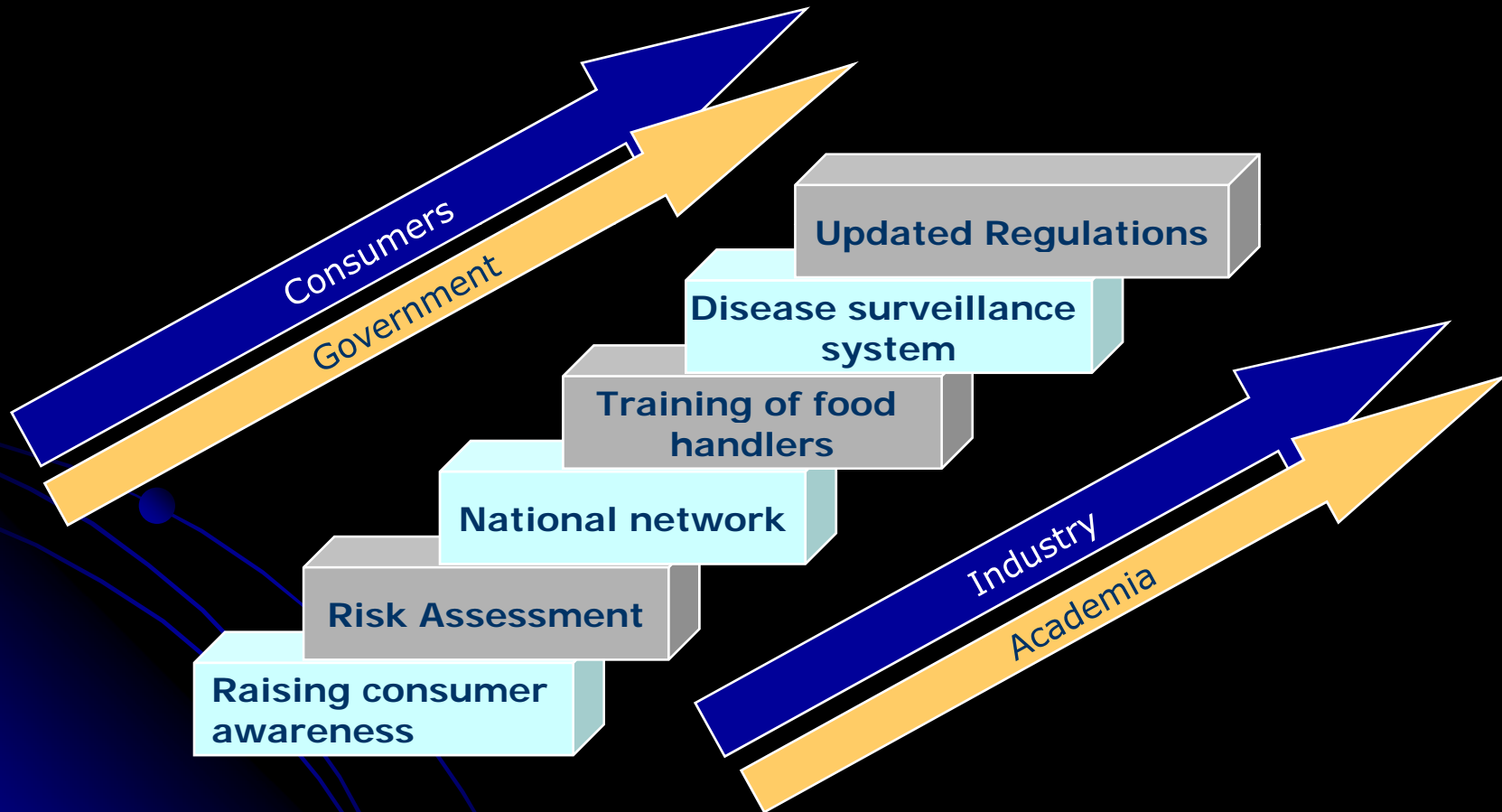
**Formulation &
Process Design**

**SAFE
FOOD**

Critical Pillars For Effective Food Safety Management



Priority Areas



“Coming together
is a beginning.

Keeping together
is progress.

Working together
is success”

Henry Ford

