



Technological Improvements in Outbreak Prevention

Managing Food Safety Practices
from Farm to Table

The National Academy of Sciences

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Prevention: 3K's

- Keep them out
- Kill them
- Keep them from growing

Keep Them Out

- **Raw Materials/ Ingredients**

- ◆ GAP/plant and animal
- ◆ quality suppliers
- ◆ certify critical (at risk) ingredients

- **Process Environment**

- ◆ Plant and Equipment Design
- ◆ GMP/ GHP

- **Prevent Recontamination of Processed Product**

Keep Them From Growing

- Formulation and Packaging (pH, a_w , Eh)
- Temperature (high or low)
- Moisture (Water, R.H.)

Kill Them

Traditional

- Heat
- pH/acidity
- Sanitizers/biocide
- Irradiation

Newer Technologies

- Pulsed Electric Fields
- Pulsed Light
- High power Ultrasonics
- Cold Plasma
- Ohmic Heating
- UV Light
- Microwave
- High Pressure
- New biocides acceptable for direct food contact

Tools To Accomplish 3K'S

- **GAP/GMP/GHP** (interior tissue of plant and animals is normally free of pathogens)
- **HACCP**
- **Cleaning and Sanitation**
- **Others** (part of GAP/GMP/GHP but often overlooked)
 - ◆ Plant and equipment Design
 - ◆ Personnel and Maintenance Practices

Practical Issues / Problems

- Contamination of **pathogen-free tissue** during harvest and primary processing
- Contaminated Raw Material without Kill Step in Process or Preparation
- Process Failure
 - ◆ Ineffective process
 - ◆ HACCP Deviation
- Post Process Contamination
- Microbiological Testing Needed to Quantify and Manage Risks

Contaminated Raw Material or Ingredients Without Kill Step

Examples:

- E. coli O157:H7 in Fresh Meats
- Salmonella & E. coli O157:H7 in Produce
- Salmonella in Dry Ingredients for Chocolate, Dry Blend Diet Drinks, etc.
- L. monocytogenes in Fresh Produce and Meats
- Campylobacter in Fresh Poultry

Post Process Contamination

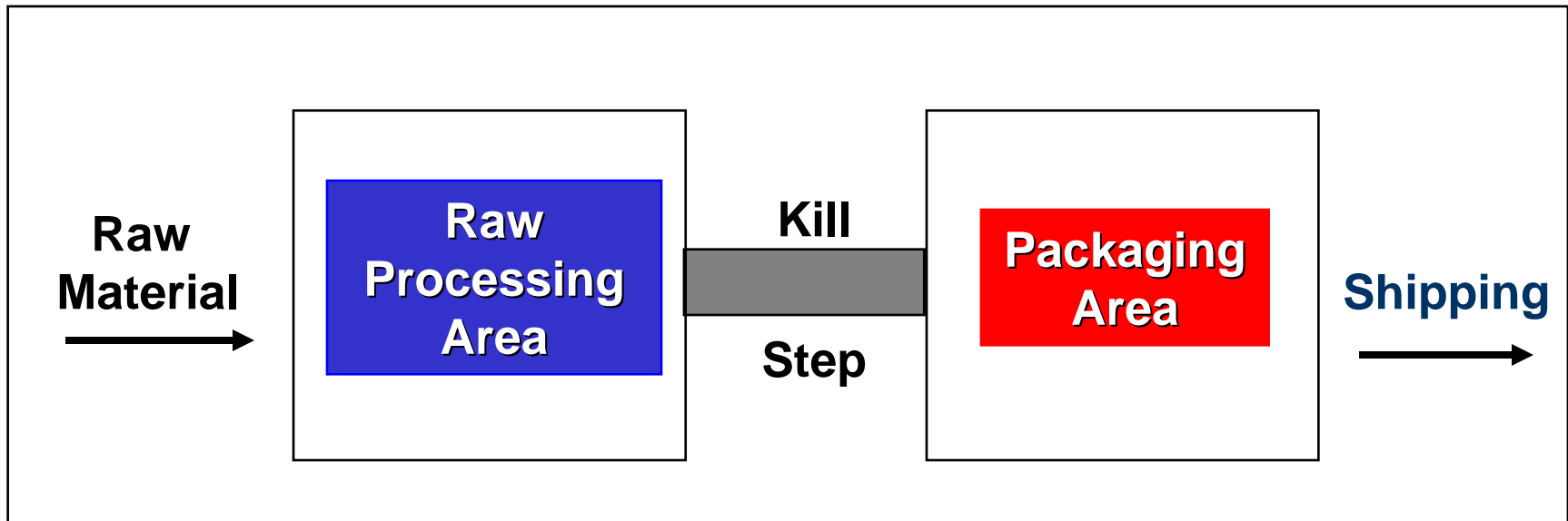
- L. monocytogenes in Cooked Meats
- L. monocytogenes in Pasteurized Dairy Products
- Salmonella in Dry Milk Products
- Salmonella in Dry Cereals and Pet Foods

“Thus the microbiological safety of many products is dependent upon preventing introduction of pathogens during harvest/slaughter and post-kill process and packaging”

Critical Aspects of Preventing Post Process Contamination

- Prevent the introduction of pathogens into the post process environment
- Prevent growth of pathogens
- Prevent distribution of pathogens from contaminated areas to product and product contact areas

The Ideal Food Plant Layout

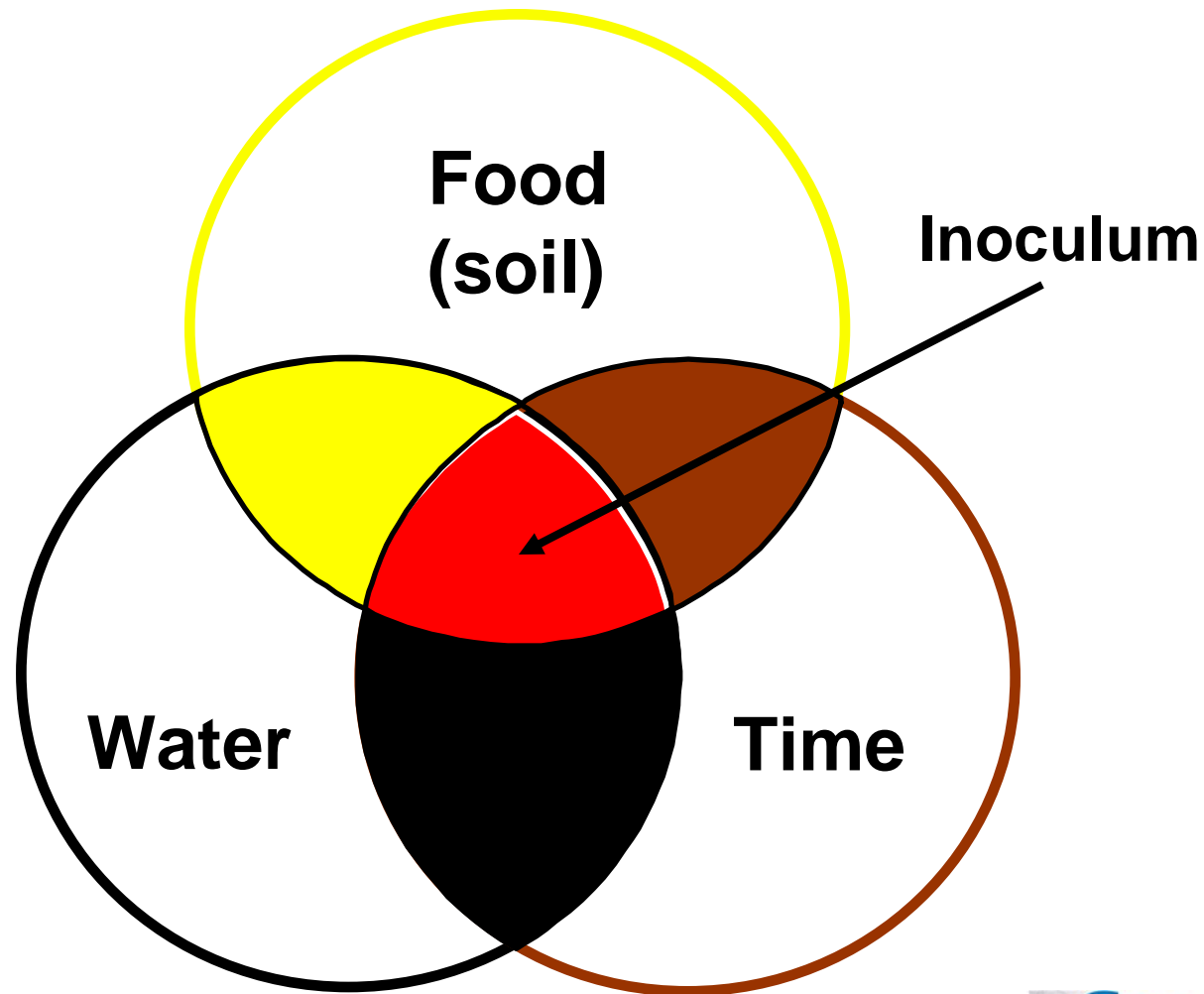


Note: Same issues apply to food preparation in homes and foods service operations

Growth of Microorganisms is Dependant Upon:

- Time
- Temperature
- Nutrients
- Moisture
- Absence of inhibitors

Requirements for Microbial Growth



Moisture Control

- ◆ Limits Growth
- ◆ Minimizes Distribution

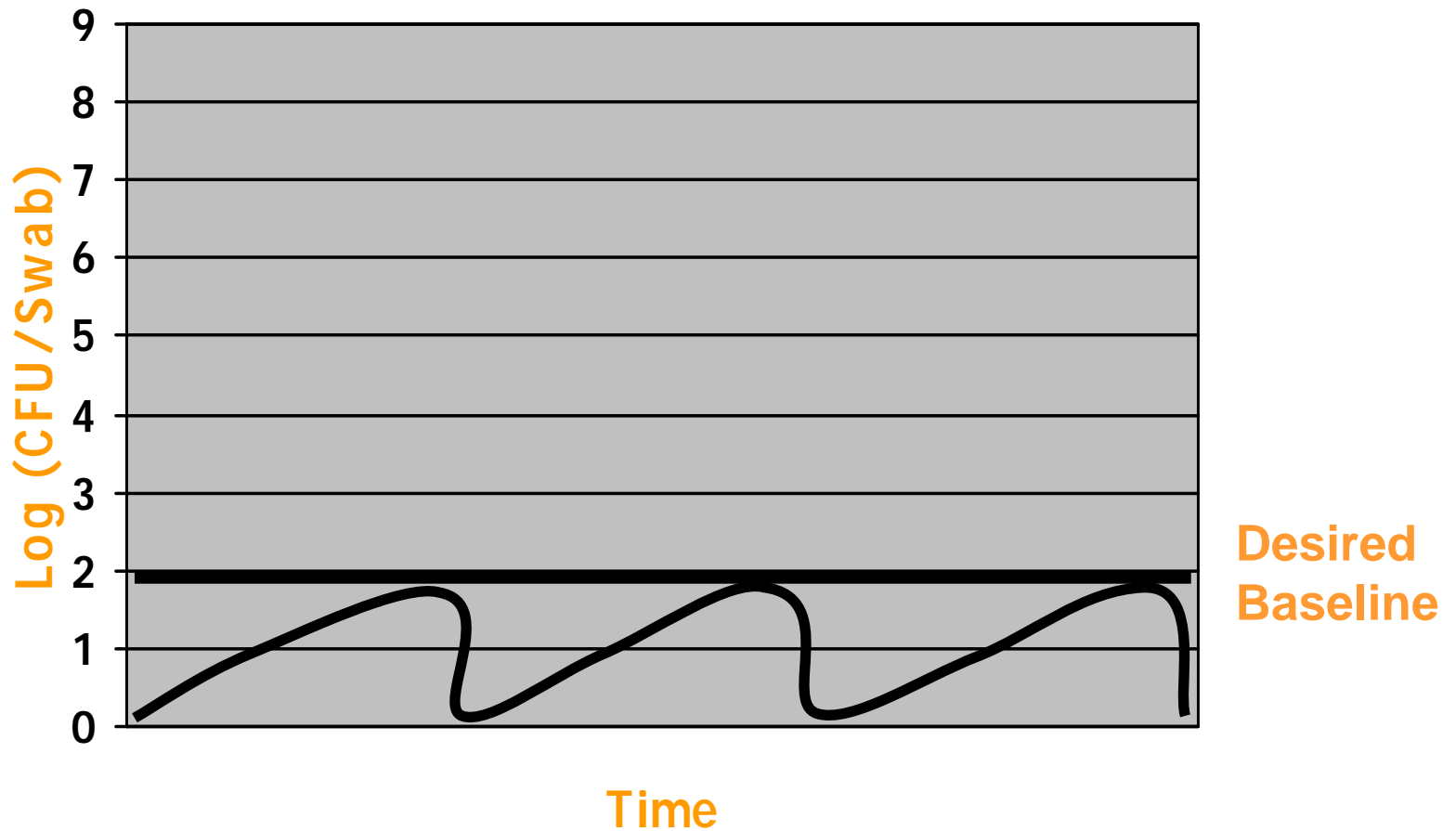
Temperature Control

- ◆ Reduced - slows or stops growth
- ◆ Elevated - accelerates growth until lethal limit is reached

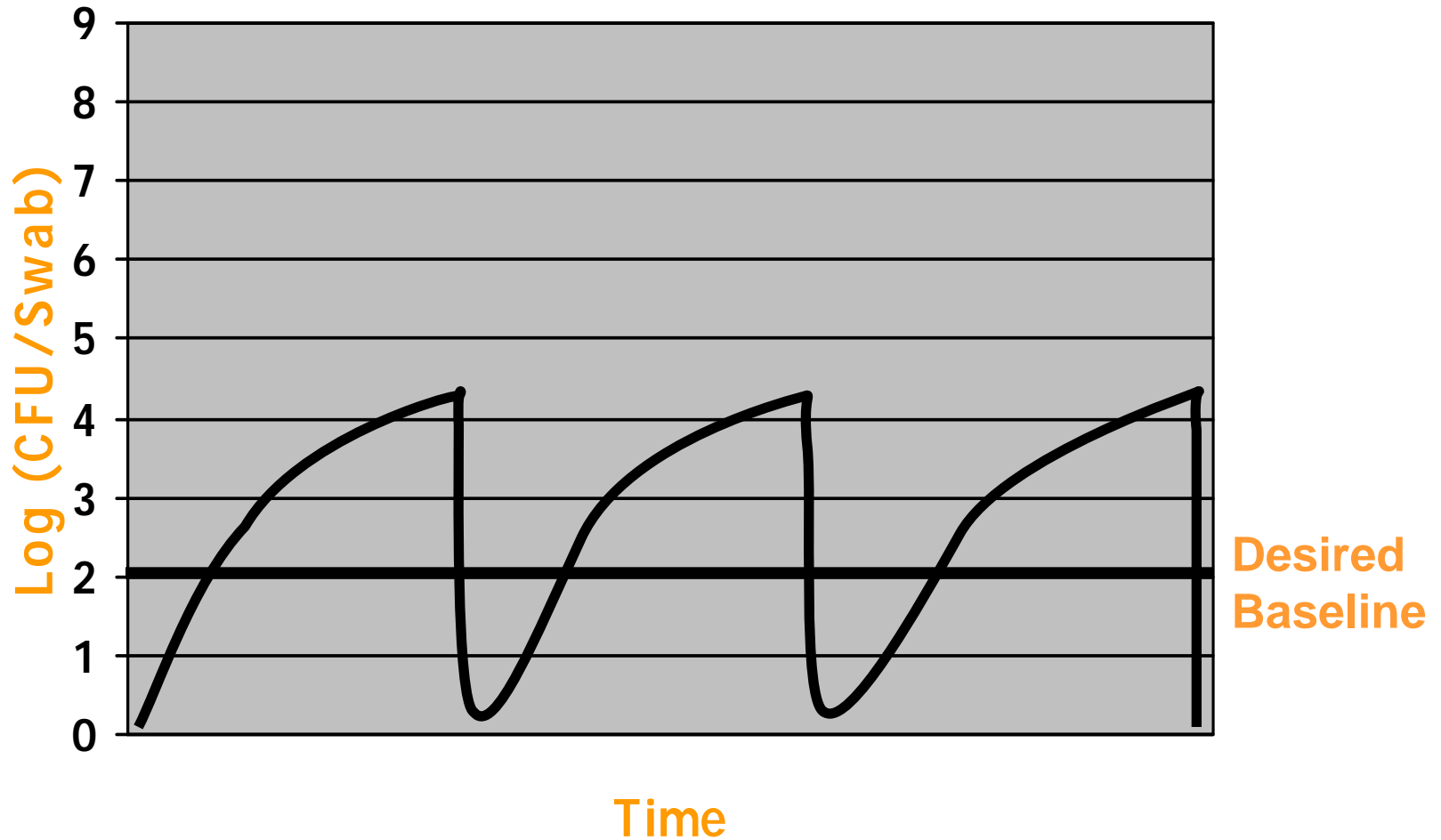
Cleaning and Sanitation

- Restarts the clock - limits time
- Removes nutrients
- Introduces inhibitors

Effective Cleaning and Sanitizing



Effective But Infrequent Cleaning and Sanitizing



Technical Aspects Of Minimizing The Severity Of A Contamination “Event”

- **Must identify and characterize the causative agent**
 - ◆ Advances in test methodology allows faster and more sensitive detection (limited to 8-24 hours)
 - ◆ Pulse Net (PFGE) or other genetic characterization (Rep-PCR)
- **Need to determine source of contamination or process failure**
- **Must have **traceability** of product and it's ingredients**
- **Must be able to differentiate between good, suspect, and bad product (lots, break points, etc.)**

Technical Aspects Of Minimizing The Severity Of A Contamination Event *(continued)*

- **Must be able to clean up plant and document that it was effective**
- **Establish and validate preventative measures for the future**
- **Must provide verification for initial product runs**
 - ◆ **HACCP**
 - ◆ **SSOP**
 - ◆ **Sampling Plans and Testing**

Recommendations RE: Practical Issues/ Problems

- **Develop data necessary to understand microbial ecology of the process environment and educate employees**
- **Use data to develop criteria for pathogens and other significant microorganisms in the process environment, and for critical ingredients**
- **Use data to improve manufacturing facilities and process flow**
- **Verify the process is under control; i.e. routine testing**

Differentiating Good from Suspect and Bad Product

- Need a good definition of a lot, and a reasonable rationale for a “break point” to separate lots relative to microbial contamination
- Requires good process, sanitation and data records

Practical Problems in Establishing a “Break Point”

- Continuous process
- Rework
- Nature of product makes it difficult to define a lot; e.g. source of carcass coming into plant
- Lack of Records to establish “break points”
- Lack of test data or non-reliable test data

Solutions to Problems in Establishing a Break Point

- Plan ahead for a potential contamination event
- Develop rationale “break points”
- Minimize Lot sizes
- Establish processes and related documentation and records retention policies
- Develop sampling plans
- Test using validated method(s) and credible (accredited) laboratories

Final Remarks

- **New Technologies to kill pathogens in foods are being developed and validated**
 - ◆ Application will provide reduce risks but will not prevent post process contamination
- **Testing technologies continue to improve the speed and sensitivity of the methods**
 - ◆ But will not provide instant results
 - ◆ Can only verify control, it is not a preventative measure
 - Limited by the number of samples needed to have confidence in the acceptability of a lot
 - Testing is more useful to verify ongoing control of the process
 - ◆ Genetic characterization of pathogens is becoming easier and more automated

Final Remarks *(continued)*

- Technology for effective traceability will continue to improve and become less expensive
- We need to better utilize the tools and knowledge we have today and adopt new technologies as they become available