Environmental Monitoring and Process Control for Spices

ASTA Annual Meeting

April , 2011

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Microbiology of Spices

- Commonly carry large numbers of bacteria and molds mainly of soil origin.
- Conditions of handling after harvest often permit extensive contamination and microbial growth although drying with heat somewhat reduces microbial numbers.
- Microbial loads of up to 10^8 CFU/g in raw materials depending on part of plant used, origin, climate harvesting, processing, storage and transport conditions.

Microbiology of Spices & Spice Production

- Predominate flora → aerobic spore-forming bacteria, non-spore-forming bacteria, indicator organisms, and pathogens may be found.
- Pathogens of concern include *Salmonella*, *Clostridium*, *Bacillus*, *Listeria* and *Staphylococcus.*
- They are cultivated in various areas of the world, many in developing countries and in areas with varying levels of good agricultural practices and sanitation.

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Spice Associated Recalls

1970 to 2003

- 21 recalls involving spices and herbs contaminated with *Salmonella;*16 occurred during 2001-2004
- 12 of them involved spices imported from other countries (India, Spain, Turkey, Egypt, Jamaica, Mexico, and Taiwan).
- Included ground black pepper, ground cumin, ground oregano, paprika, red pepper powder, sage, sesame seeds, ground thyme and basil leaves.

2010 Recall & Outbreak

Black Pepper and Cursed Red Pepper Recalls 2010

- Foodborne illnesses: 272 persons in 44 states and DC (July 1, 2009- April 14, 2010)
- *Salmonella* Montevideo
- Black pepper and crushed red pepper (applied to salami post-lethality)



ICMSF Recommendations for Minimizing Product Recontamination (2002)

The International Commission on Microbiological Specifications for Foods (ICMSF) recognizes that, while it is not possible to prevent the introduction of pathogens into food processing facilities, it is crucial to minimize their presence:

- ***Raw agricultural commodities need physical separation*** through plant design and layout in order to minimize entry of pathogens into processed product areas

ICMSF Recommendations for Minimizing Product Recontamination (2002)

- ***Food handlers and maintenance personnel can be a source*** *of* food contamination and must be trained in proper hygiene principles
- ***Personal clothing, in particular shoes, can transfer pathogens*** from one area to another and must be controlled
- ***Air and water must be controlled. Compressed air filters can be a*** source of contamination if not properly maintained and water aerosols can disperse microorganisms throughout the facility if not controlled

ICMSF Recommendations for Minimizing Product Recontamination

- ***Insects and other pests can act as vectors of pathogen*** transmission in the food manufacturing plant if not properly controlled
- ***Transport equipment such as racks, trolleys, carts, forklifts and*** similar equipment can be important vectors for transferring microorganisms throughout a facility and should be limited to use in specific areas

Lessons Learned from Other Commodity Groups

GMA
The Association of Food, Beverage and Consumer Products Companies

CONTROL OF *SALMONELLA* IN LOW-MOISTURE FOODS

February 4, 2009

(Minor corrections March 16, 2009)

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Grocery Manufacturers Association (GMA) Outlined Seven (7) Elements:

- To minimize the risk of *Salmonella* contamination in low-moisture products.
- To be used to develop a new food safety system or augment an existing system already employed by a manufacturer or supplier

GMA's 7 Elements for *Salmonella* Control in Low-Moisture Products

1. Prevent ingress or spread of *Salmonella* in the processing facility.
2. Enhance the stringency of hygiene practices and control in the Primary *Salmonella* Control Area.
3. Apply hygienic design principles to building and equipment design.

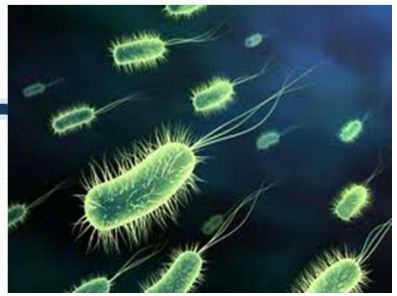
GMA's 7 Elements for *Salmonella* Control in Low-Moisture Products

4. Prevent of minimize growth of *Salmonella* within the facility.
5. Establish a raw materials/ingredients control program.
6. Validate control measures to inactivate *Salmonella.*
7. **Establish procedures for verification of *Salmonella* controls and corrective actions.**

7. Establish procedures for verification of *Salmonella* controls and corrective actions.

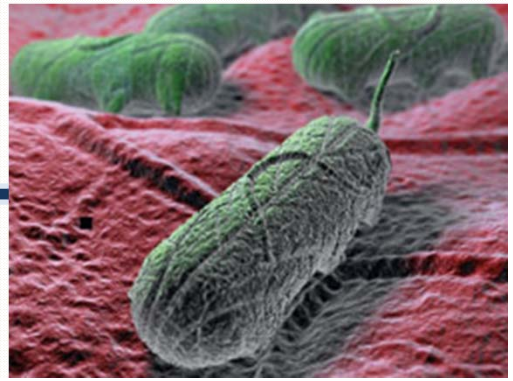
- The adequacy of a pathogen control program should be **verified on an ongoing basis** to assure effectiveness and to drive continuous improvement.

- Verification should focus on implementing a **robust monitoring program** that has been designed to identify transient and/or resident *Salmonella* in the processing areas.



- Monitoring results provide critical information to **improve** *Salmonella* control in the plant environment
- This information should be used to correct problem areas **before** they pose a risk to finished product.
- A robust environmental monitoring program is **one of the many** prerequisites programs that together provide a firm foundation for effective food safety management.

- The target organism for monitoring low-moisture foods should be *Salmonella* – more persistent in the environment that other organisms such as coliforms and Enterobacteriaceae.
- There is no correlation with other groups of indicators such as Aerobic or Total Plate Count (APC).



PEM Program

Pathogen Environmental Monitoring Program

- The most effective tool for determining the effectiveness of a facility's *Salmonella* controls is the implementation of an **aggressive** Pathogen Environmental Monitoring Program (PEM.)
- A PEM is an **on-going measure** of the **effectiveness** of the overall *Salmonella* control program in the plant.
- It is **not**, in itself a *Salmonella* control program.
- It provides **feedback** on where efforts need to be directed for the overall control program.

Principles of a PEM Program

Implementing a PEM program may, at first, seem like a daunting undertaking:

- …it is a logical, systematic approach that can be developed in fairly short order but will take time to completely reach "steady state"
  - It is a data driven "**seek and destroy**" program – "**follow the data**"
- …encourage employees to find the pathogen or its indicator if there…Only then can you react and do something about it.

Principles of a PEM Program

- A PEM program is specific to the individual facility under consideration and specific to the individual operations within the facility.
  - Other than the common principles discussed, there is no "one size fits all" program
- If you do not have a food safety professional on staff …make use of an experienced outside expert or process authority to guide you through the process.

Getting Started…

- Assemble your team; designate a team leader
- Assemble a cross functional team familiar with your operation to help identify potential areas of risk or concern, including:

  * Quality manager
  * Microbiologist
  * Sanitation
  *Operations Manager
  * Plant Engineer
  * Maintenance
  * Line Supervisor
  * Warehousing

Getting Started…

- …understand your process flow with an emphasis on identifying potential points of product recontamination
  - Blueprints and flow diagrams; walk the plant floor
- …conduct environmental monitoring in raw areas, but you need to understand that you <u>will occasionally find *Salmonella in those areas*</u>

Principles of a PEM Program

Microbiological monitoring of the food processing environment can be performed to meet a number of objectives

- Verifying the effectiveness of cleaning and sanitation practices
- Determining the frequency required for cleaning and sanitation
- Determining the presence of foodborne pathogens or their indicators in the environment and on equipment
- Determining environmental sources of spoilage organisms
- Determining the frequency required for special maintenance procedures (e.g. changing air filters)
- Evaluating the hygienic design and fabrication of food processing equipment and facilities

Principles of a PEM Program

- It is more practical and reliable to monitor the processing environment than to rely solely on finished product testing…cannot test safety into the product.
- Environmental monitoring has a multitude of benefits
  - Provides dynamic information on the state of a processing line and the PSCA
  - Can be used for identifying harborage niches
  - Can be used for trend analysis and measuring effectiveness of corrective actions
  - Is flexible and can be tailored to specific situations

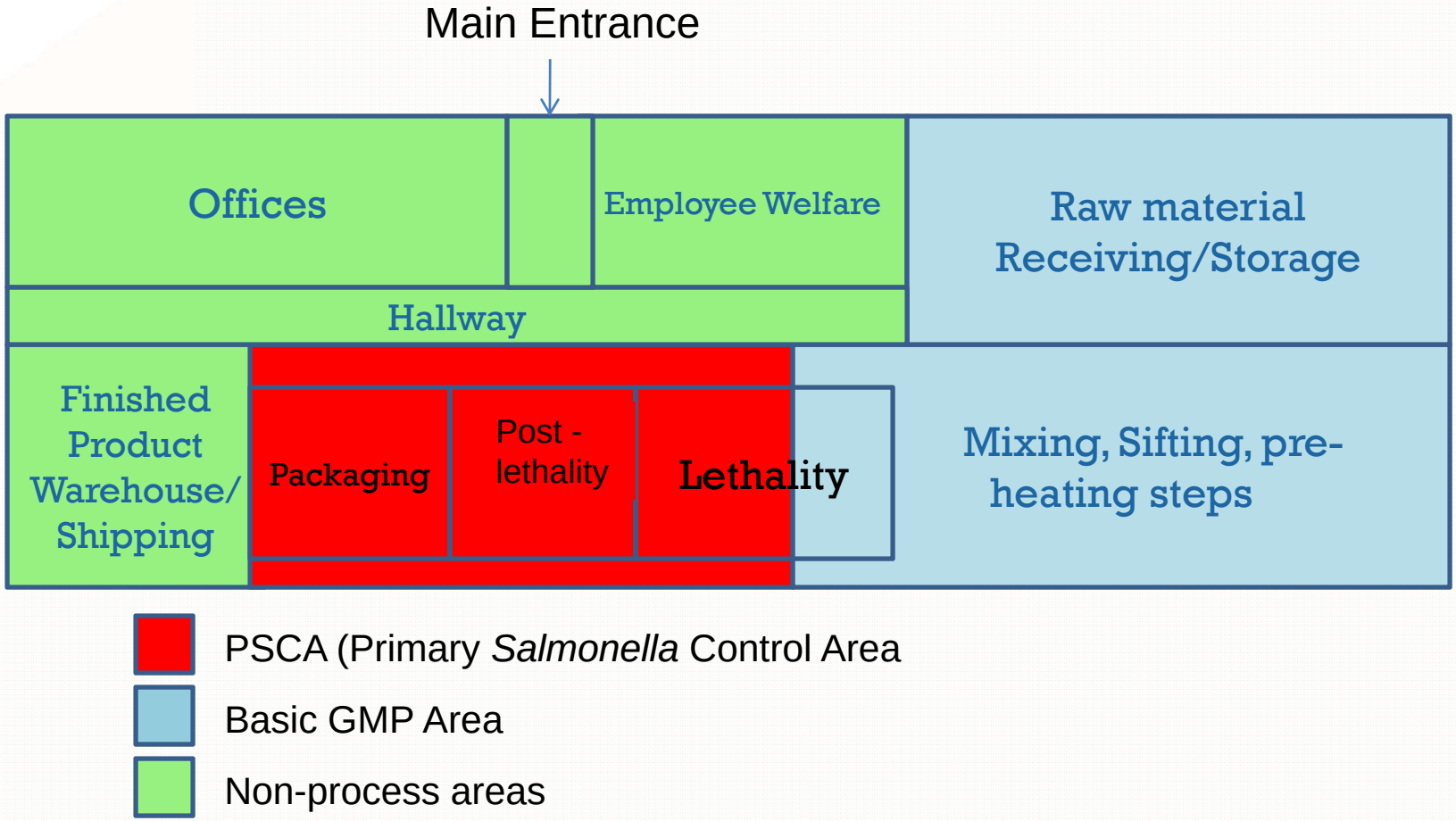
Hygienic Zone Assessment

- Conduct a hygienic zone assessment to determine what is considered the Primary *Salmonella Control Area (PSCA)*
  - areas where post-lethality treated product (finished product) is exposed to the environment….the Ready-to-Eat (RTE) area → the high hygiene or high risk area
- The objective of hygiene zones:
  - is to identify areas of high and low risk to the product within the manufacturing operation
  - to prevent the spread of salmonellae into the PSCA where protection of the exposed post-lethality product is critical.

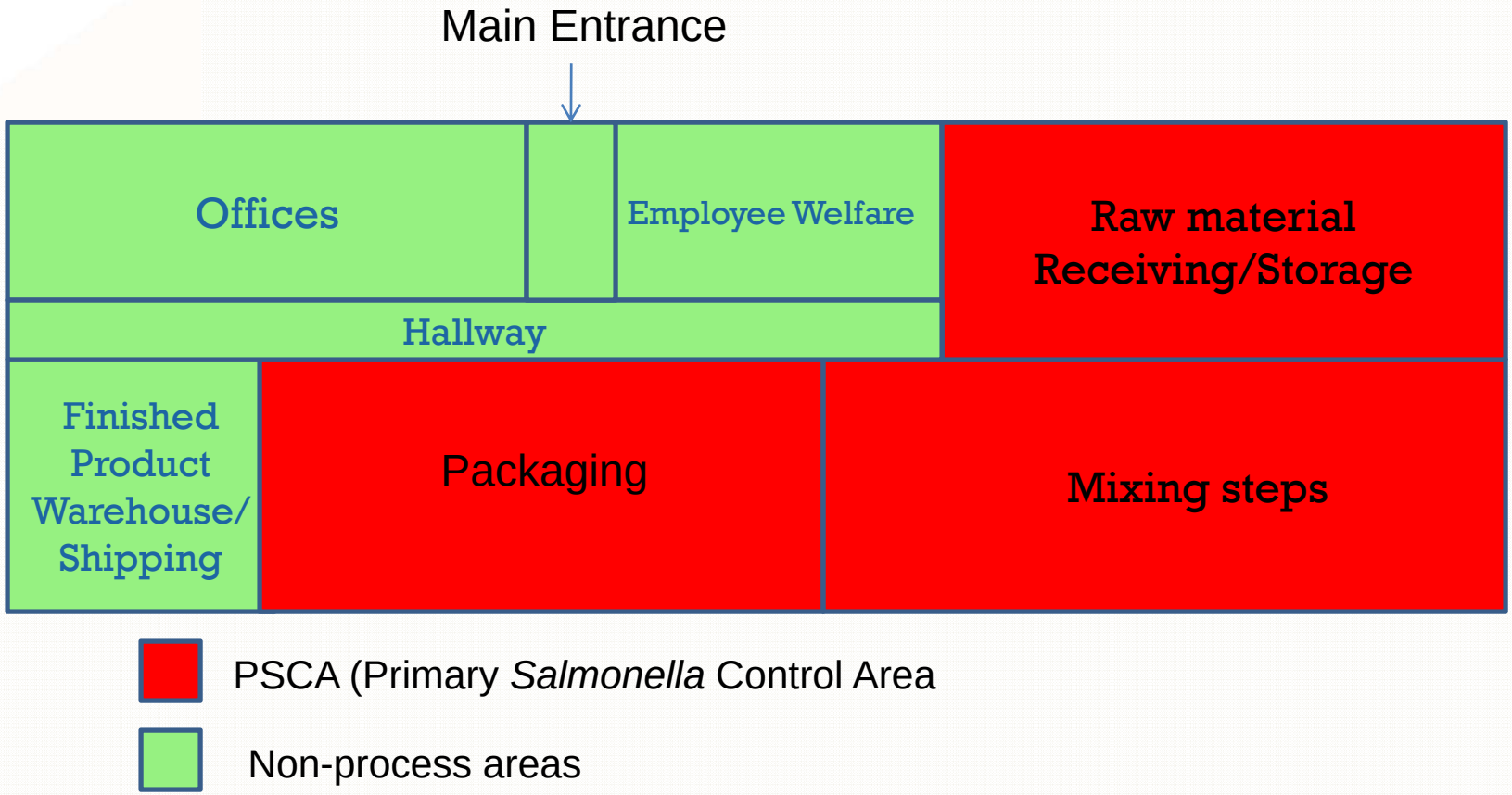
Hygienic Zone Assessment

- Conduct a hygiene zone assessment of the entire facility and create a color-coded map:
  - Evaluate all production areas, storage, receiving, warehousing and loading docks, employee facilities such as cafeterias, break rooms, locker rooms, washrooms, maintenance areas, offices/conference rooms, etc.
  - Designate the PSCA, basic GMP areas, transition areas, and non-processing areas
  - Pay particular attention to areas within the facility where ingredients, products, or the environment could be a potential source of *Salmonella* and a high potential to recontaminate post-lethality treated product
  - Also pay attention to non-process areas such as forklift charging stations, refuse/recycling areas, restrooms and others that could impact the PSCA

Plant Layout



Plant Layout



Sample Locations & Zoning

- Map out the hygiene zones → select the specific sampling sites within each area.
- Use the PEM zoning concept in order to aid in site selection and in tracking environmental data
  - The PEM zoning concept is different than mapping hygienic zones within the facility
- In the PEM zoning concept the plant operations are divided into four zones based on level of risk

Zone 1

Zone 1 - Areas in the plant that are direct product contact surfaces after the lethality or microbial reduction step (e.g. roaster) and before the product is sealed in the primary package

- If there is no lethality step in the process - sites where the product is exposed to plant equipment and environment prior to sealing in the primary packaging

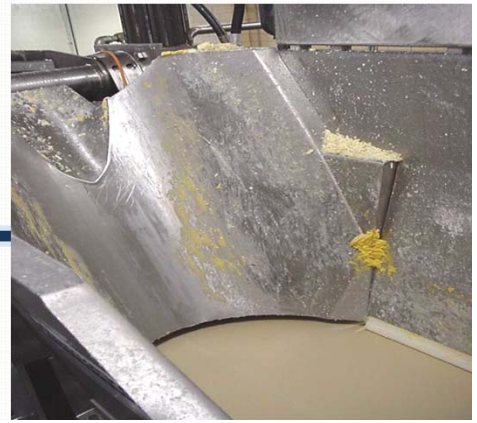
✓ Conveyor belts/buckets

✓ Utensils

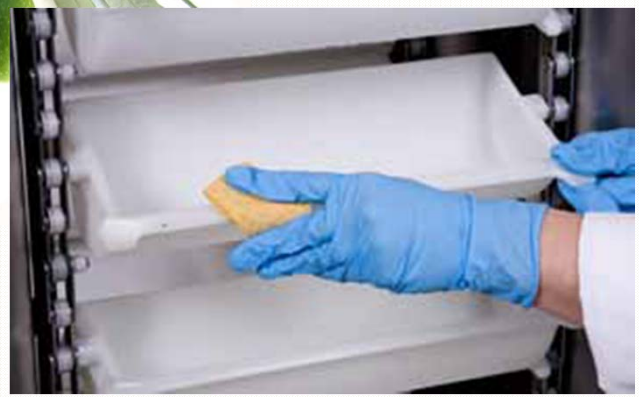
✓ Employee hands (if touching product)

✓ Slicers/dicers; Product hoppers/bins/bin liners

✓ Discharge Chutes; Fillers



Zone 1 Sampling






Zone 2

Zone 2 – Non-product contact areas in the plant that are closely adjacent to product contact surfaces

- ✓ Equipment framework
- ✓ Drip shields/housings
- ✓ Control panels/buttons
- ✓ Overhead pipes directly over zone 1 surfaces
- ✓ Computer screens
- ✓ Maintenance tools

Zone 2 Sampling



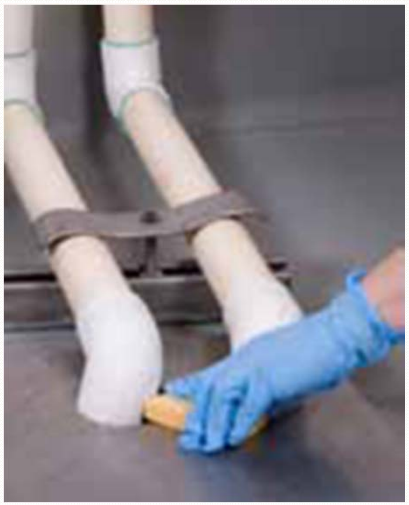



Zone 3

Zone 3 – Non-product contact surfaces that are in open post-lethality product processing areas, but no closely adjacent to zone 1 surfaces

- Zone 3 surfaces have the possibility of leading to product recontamination
  - > Floors, walls, ceilings
  - > Hoses
  - > Drains
  - > Condensate drip pans
  - > Trolleys, forklifts, walk-alongs, carts
  - > Trash containers
  - > Pallets
  - > Foot baths/mats
  - > Brooms/mops
  - > Toolboxes

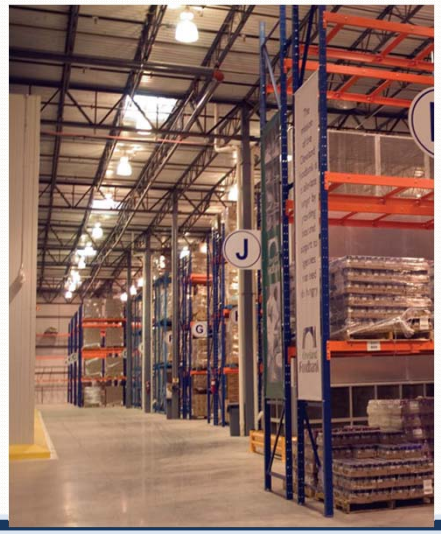
Zone 3 Sampling



Zone 4

Zone 4 – Areas remote from post-lethality product processing areas

- Zone 4 areas if not maintained in good hygienic condition can lead to cross-contamination of zone 1– 3 areas (PSCA)
  - ✓ Hallways; Loading docks
  - ✓ Bathrooms; Locker rooms
  - ✓ Employee cafeteria/break rooms
  - ✓ Coolers/freezers
  - ✓ Maintenance shop
  - ✓ Office areas



Zone 4

Sanitary Zones

Zone 1

Product Contact Surfaces

(Fillers, hoppers, screens, conveyor belts, air blowers, employee hands)

Zone 2

Non-Product Contact Surfaces

(framework; refrigeration units, equipment housing)

Zone 3

Other Areas within RTE Room

(air return covers, phones; hand trucks, forklifts, drains)

Zone 4

Areas Outside of RTE Room

(Locker rooms, cafeteria, hallways, loading dock, maintenance areas)

Testing Methods

- There are a myriad of sampling and testing methods that can be employed for your PEM program
  - Recommended sampling methods include:
    - Surface sampling using sponges/swabs
    - Product residue scrapings/fines/dust samples
    - Water/rinse samples
    - Air samples

- Generally, a comprehensive, aggressive PEM program uses a combination of these sampling methods

PEM Sampling and Testing Methods

- There are two general categories of test methods that you can use for your PEM program
  1. Testing for the specific target pathogen (*Salmonella spp.)*
  2. Testing for indicators for the potential presence of salmonellae

- There are a number of indicator tests that can be used for PEM programs in low moisture processing operations:

  Coliforms/*Escherichia coli;* Total *Enterobacteriaceae counts (TEB counts);* APC's for quality however cannot be used as a safety indicator for pathogens because in almost all cases there is no correlation

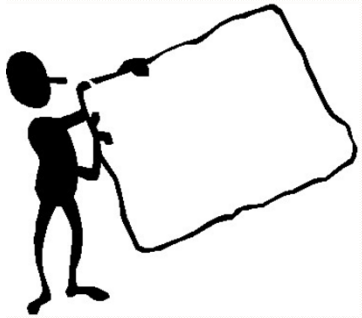
- Newer technologies look at molecular markers for pathogens and pathogen virulence factors or a combination of pathogen and non-pathogen markers.

Establish A Baseline

- Once potential areas for sampling are identified → conduct preliminary intensive investigational sampling to find salmonellae if present.
- Samples are collected at a much higher frequency than is done for the ongoing PEM program.
- Zone 1 sites may be tested for TEB counts pre-operationally, after cleaning and before sanitizing (prior to start-up of the production line) as a measure of cleaning effectiveness

Data Interpretation & Corrective Actions

- Your facility should have a pre-determined action plan that would be implemented in the event of a *Salmonella positive result*
  - The action plan should be specific for each of the four zones and include
    - ✓ Type of immediate corrective actions to be taken by zone
    - ✓ Actions to be taken to verify *Salmonella has been eliminated* from the area in question
    - ✓ A root cause analysis to find the source of the contamination so that it can be prevented in the future



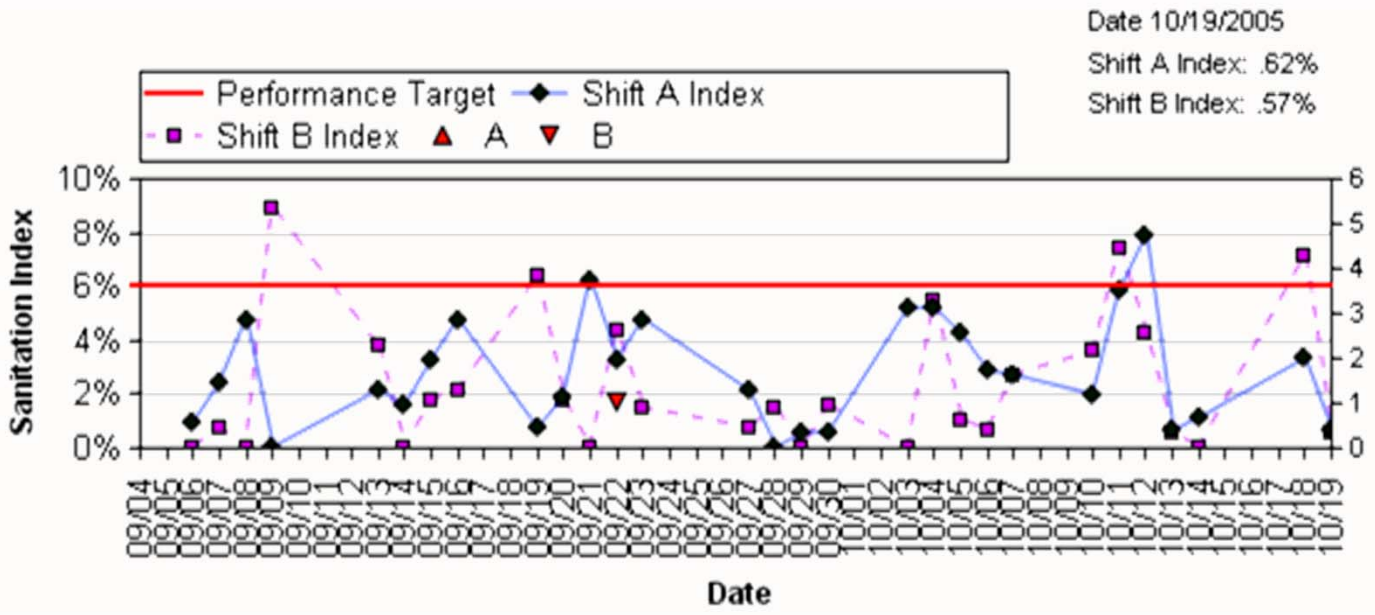
Data Interpretation & Corrective Actions

- In the event of a *Salmonella positive, the response team should* conduct an in-depth investigation looking at
  - Any maintenance disruptions/activities
  - In-plant construction
  - Unplanned down time
  - Other non-standard production activities (e.g. R&D plant trial)
- The response team should look at these factors and all relevant records and documents from last full microbiological cleanup/sanitation to the current positive finding
- **Track and trend the results of testing**!

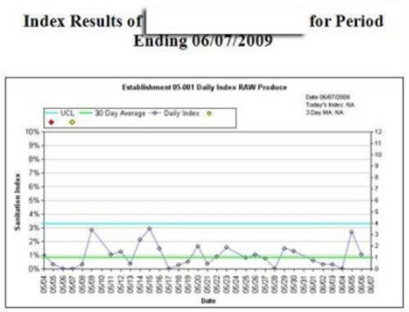
Process Control

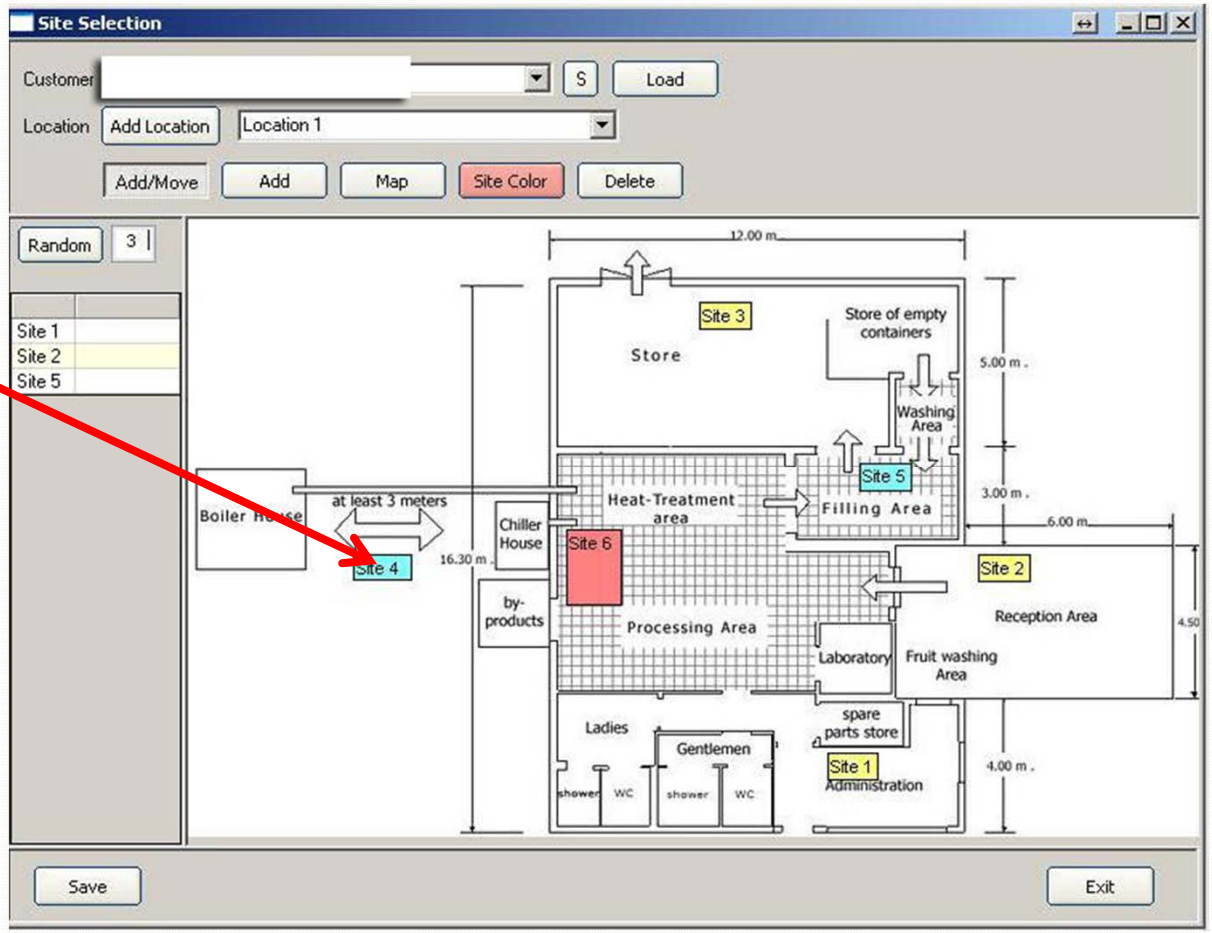
Process Control– the advantage:

- Monitor production to detect risk of exceeding control limits
- Evaluate performance of suppliers
- Provide warning of potential pathogen event
- Narrow down problem, i.e. employee vs. process-induced



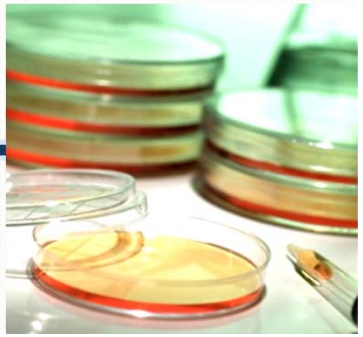
Data Utilization





Addressing the Testing Dilemma

- Develop a testing program that
  - Ensures both the safety & quality of the finished products
  - Monitors, verifies, & provides feedback to the production process
  - Is customized for the matrix nuances of each food product
  - Will not have unintended consequences
  - Will not have ‘blind spots’



Challenge with Low Moisture

- Challenge with pathogens and spices is how you handle the raw product → have to assume constant in-coming load of pathogens such as *Salmonella*.
- Separate processes, wet for dry; raw from finished product; people and product traffic → → control it on your finished product side.

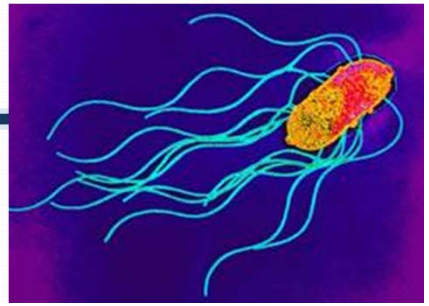
Factors That Must Be Controlled in Spice Processing Facilities

- Raw and pasteurized product should be physically segregated to minimize the potential for recontamination
- Traffic flow (both people and materials) throughout the plant should be controlled
- Cleaning and sanitation procedures need to be effective and validated

Salmonella Control Equation

Controlled Traffic Patterns + GMP's + Dust/ Moisture Control + Sanitary Design of Equipment &Facilities

+ Effective Sanitation Procedures Controls = ***Salmonella* Control**



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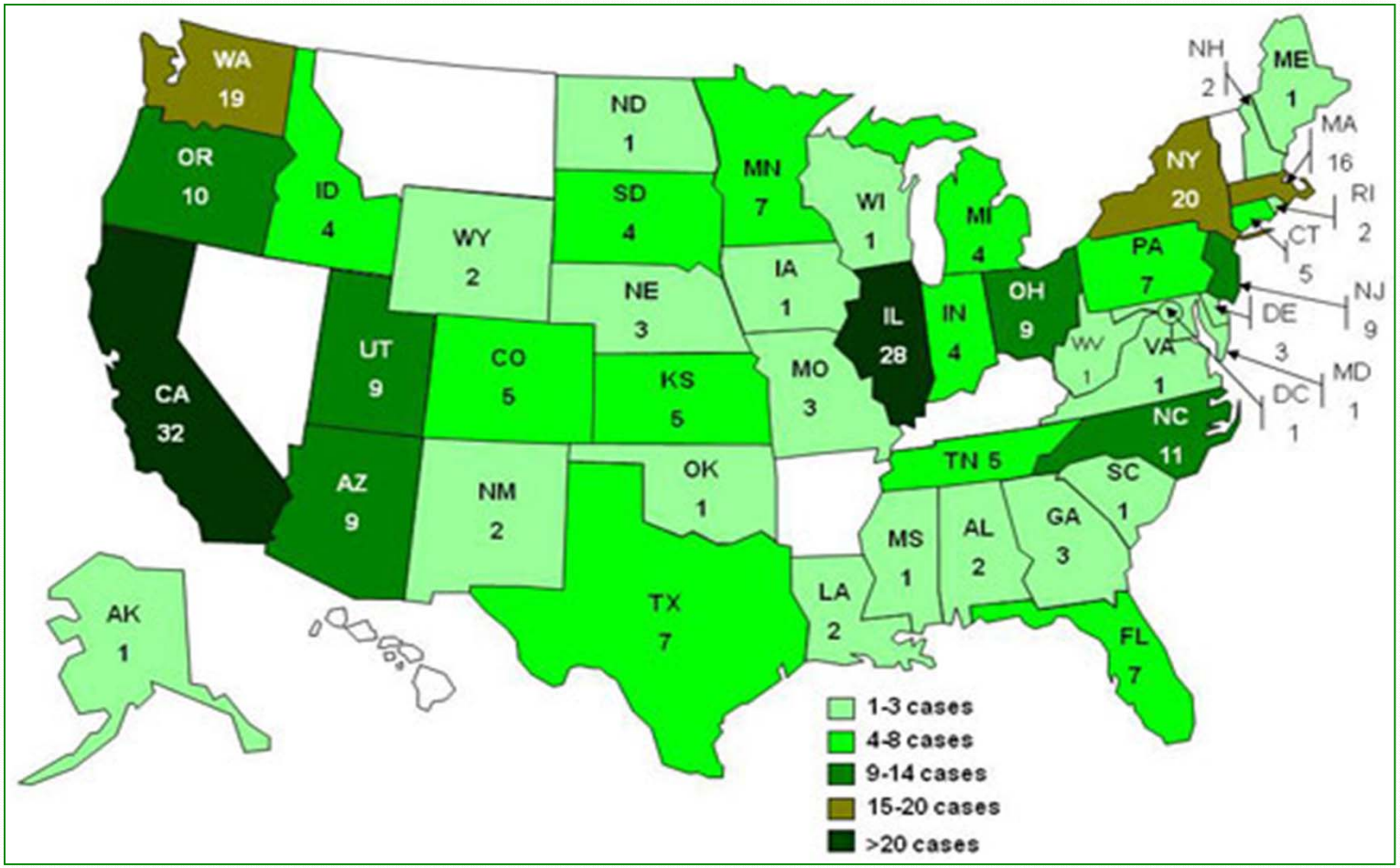
Persons Infected with the Outbreak Strain of *Salmonella* Montevideo by State



Questions?

Thank you!


Today
Sonoran AB - Associate Group
Tomorrow
Two sessions during continental breakfast
Dunes A -Technical Update
Dunes B - Government Relations Update
Vaquero E-G
ASTA Business Meeting at 9:00am (ASTA members only)
General session at 10:45am (all attendees)