

Nut Handling and Processing for Confectioners and Small Nut Roasters

Session 3: Reducing Pathogens and Validating Nut Roasters
Dr. Steve Goodfellow, Deibel Labs

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Nut Handling and Processing for Confectioners and Small Nut Processors

Reducing Pathogens and Validating
Nut Roasters

Dr. Steve Goodfellow
Deibel Laboratories, Inc



Nut and Seed Validations Performed or Requested

- Almonds
- Brazil nuts
- Cashews
- Filberts
- Hazelnuts
- Macadamia nuts
- Peanuts
- Pecans
- Pistachios
- Pumpkin Seeds
- Sunflower Seeds
- Walnuts



Microbial and Pathogen Reduction Options Available

- Dry Heat
- Moist Heat
- Oil Roasting
- Sanitizers
- Gas Treatments
- High Pressure
- Irradiation



Reduction Options Currently Employed by Industry

- Dry Heat
 - Roasting Ovens, Belt Style, Dry Product
 - Drying Ovens, Belt & Batch Style, Moist and Dry Product
- Moist Heat
 - Steam Injected Roasters
 - Steam Injected Conveyors
 - Hot Water, Belt & Batch Style
- Oil Roasting, Belt and Batch Style
- Sanitizers, Chlorine & Peracetic Acid
- Gas Treatment, Batch, Propylene (Ethylene) Oxide



Dry Heat

- **Belt Roasters**
 - Hot Dry Air, Convection
 - Require Specific Time/Temperature Parameters
 - Examples per Almond Board (°F)
 - 265 for 45 minutes yields 3.8-4.5 log reduction
 - 280 for 25 minutes yields 3.6-4.5 log reduction
 - 295 for 15 minutes yields 4.0-4.6 log reduction
 - 310 for 12 minutes yields 4.2-5.0 log reduction
- **Dryers**
 - Both Belt & Batch Styles
 - Used for In-shell Salted Products
 - Used for Shelled Flavored Products
 - Reduction Efficacy Dependent on Surface Moisture Level and Time/Temperature
- **Customized Dryers**



Moist Heat

- Steam Injected Roasters, Gravity Feed
- Steam Injected Conveyors
- Hot Water Blanching, Belt & Batch Styles
- All systems, Efficacy Approaches USDA Appendix A for product surface reduction



Oil Roasting

- Submerged Roasting, Time/Temperature Dependent
 - Almond Board Example-260° F for 2.0 minutes to yield a 5 log reduction
- Highly Efficient, Frequently combined with salt or flavorings
- Important Factors
 - Raw Nut Temperature
 - Raw Nut Moisture Content
 - Bed Depth & Circulation



Sanitizers

- Chlorine and Peracetic Acid have been employed
- Limited to treatment of Hard In-shell product
- Efficacy is limited to the shell
- Reduction is limited to a 0.5-1.5 log value



Gas Treatment

- Propylene Oxide
- Frequently employed in Pasteurization of raw almonds
- Example, Harris, Et. al. J. Food Prot., 2005
 - PPO (05 kg/m³, 1-2 days, 38-43⁰ C yields a 5+ log reduction in inoculated Salmonella



General Validation Procedures

- Review plant construction
- Review processing line layout and Process flow diagram
- Review GMP, Sanitation and Pest Control programs
- Review HACCP Program
- Review Documentation of Processing Line Instrument Calibration
- Evaluate Post-processing Handling of Product



Non-Surrogate Validations

- Oil Roasting requirements for a 5 log reduction in potential Salmonella have been published for Almonds and Peanuts
- The assumption is made that these parameters listed previously will apply to all oil roasted nuts and seeds
- Gas treatment parameters have also been published
- These reduction options currently do not include validation with a surrogate
- Validation requirement for these options include
 - Conducting the General requirements listed previously
 - Recording Raw Product temperature
 - Using instrumentation, thermocouples, recorders, data loggers to verify actual time/temperature requirements
 - Verifying maximum bed depth and Throughput



Surrogate Validations

- Surrogate typically employed is a *Enterococcus faecium* strain ATCC 8459
- This strain is non-pathogenic and has been demonstrated to have the same or higher resistance to dry heat, moist heat and oil roasting as Salmonella strains
- The surrogate's relative resistance to sanitizer and gas treatment has not been published



Surrogate Validations (cont.)

- **General Surrogate Validation Process**
 - Company supplies the laboratory with the product to be validated
 - Laboratory grows large quantities of the surrogate, harvests the surrogate and inoculates the product with high numbers with the target level being $> 10^7$ per gram
 - The inoculated product is dried back to its original moisture level, placed in an impermeable bag and kept refrigerated through transport to the processing plant
 - Personnel validating the process arrive at the plant, distribute the surrogate inoculated product into wire mesh basket or cloth mesh bags, tempering the inoculated product to the lowest temperature processed by the plant.



Surrogate Validations (cont.)

- **General Surrogate Validation Process (cont.)**
 - Containers with inoculated product are imbedded into regular product and processed through the equipment being validated
 - Validation parameters generally consist of the lowest temperature, shortest time, and deepest bed depth employed by the plant under maximum throughput conditions.
 - Containers with inoculated product are recovered, inoculated treated product transferred to Whirl-Pak bags and the samples transported back to the laboratory for analysis
 - Appropriate uninoculated and inoculated untreated controls are also sent back to the laboratory
 - Laboratory analysis confirms survival level and log reduction



General Validation Protocol

- For each set of parameters on a given piece of equipment, the surrogate validation should be conducted with:
 - Multiple Runs
 - Multiple Samples per run
 - All samples analyzed in duplicate



Minor Factors Impacting Validation Studies

- Raw Product Temperature
- Product Size, i.e.. pieces splits, halves , whole
- Moisture Content of Raw Product
- Bed Depth



Major Factors impacting Validation Studies

- Surface Moisture level of Product
- Improperly Calibrated Plant Instrumentation
- Poorly Cleaned Conveyor Belts
- Improper Air Distribution (Cold Spots)
- Improper Oil Circulation (Cold Spots)



General Validation Cost Factors

- Number of Products Validated
- Number of Equipment Types Validated
- Number of sets of Test Parameters per Piece of Equipment
- Time Frame, Generally 1-2 days Professional time at Processing Plant



Specific Validation Cost Factors

- Non-Surrogate Costs
 - Professional Time/Hourly Rate
 - Usually 6 hours, Culture Preparation, Inoculation, report preparation
 - 8-16 Hours Plant time
 - Travel Time/Hourly Rate
 - Varies with Plant Location
 - Shipping Charges
 - Surrogate Costs
 - Same as above Plus Analyses charges, usually 30 Analyses per piece of Equipment for each set of parameters validated
 - Estimated costs, based on Parameters above, generally range from \$4,000 to \$10,000 per plant



OBSERVATIONS AND CONCLUSIONS

- The potential for sporadic, low level contamination of raw agricultural products with bacterial pathogens is probably unavoidable
- The vast majority of companies processing nuts and seeds have effective treatments to eliminate this potential contamination
- Validation of these processing treatment is an essential part of ensuring food safety
- Verifying the processing treatments with surrogate cultures can present challenges with custom designed equipment or with equipment that makes recovery of surrogate-inoculated product difficult



OBSERVATIONS AND CONCLUSIONS

- Relatively even heat distribution throughout the processing treatment is essential
- Given the efficiency of the majority of the microbial reduction processing steps, the greatest challenge to the industry is to prevent post-processing contamination. This must emphasize:
 - Air Flow
 - Dust Control
 - Personnel Control-GMP's
 - Equipment Control-Sanitation
 - Segregation of finished processed product



Questions?

For Q&As and Food & Nut Safety Resource Guide:
<http://www.ecandy.com/Content.aspx?ContentID=7134>

