


Your Responsibilities as Macadamia Nut Handlers

Aurora A. Saulo

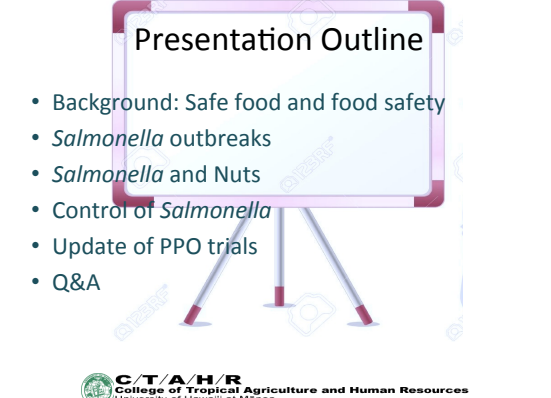
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Your Responsibilities as Macadamia Nut Handlers

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Presentation Outline

- Background: Safe food and food safety
- *Salmonella* outbreaks
- *Salmonella* and Nuts
- Control of *Salmonella*
- Update of PPO trials
- Q&A

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**BACKGROUND—
SAFE FOOD AND FOOD SAFETY**

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Selling Safe Food is the Law!

- Federal Food, Drug, and Cosmetic Act (21 U.S.C. 301 et seq.) prohibits the sale of adulterated or misbranded foods.
- Safe and wholesome food makes good business



Source: <http://www.smokernewsworld.com/smoke-free-laws/>



Definition of Food Hazard or Food Safety Hazard

- Any agent or property or facility
 - That is reasonably likely to cause illness or injury in the absence of its control (*Juice HACCP*)
 - That may cause a food to be unsafe for human consumption (*Seafood HACCP*)
 - That may cause a food to be unsafe for human consumption (*Meat and Poultry HACCP*)



Food Safety Hazards FDA FSMA Public Law 111-353 Sec.103.(b) (1) (A) and (B)

FOOD	HAZARDS
Biological	Pesticides
Chemical	Drug Residues
Physical	Decomposition
Radiological	Unapproved Food and Color Additives
Natural Toxins	Naturally Occurring or Unintentionally Introduced
Parasites	Intentionally Introduced, including by Acts of Terrorism
Allergens	

Source: <http://www.fda.gov/Food/FoodSafety/FSMA/ucm247548.htm>



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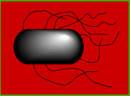
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What Microorganisms are of Concern to the Food Industry?

- Molds
- Yeast
- Viruses
- Parasites
- Bacteria



→ All raw foods contain spoilage microorganisms that need to be controlled or destroyed.



Which Microorganisms are the Most Troublesome?


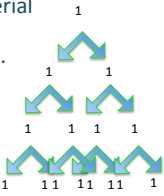
Bacteria!

- Bacteria are like people. They need:
 - Food: most important condition
 - Moisture: food needs to transfer through cell walls
 - Oxygen
 - Temperature and time for growth



Bacteria Grow Logarithmically!

- Under optimum conditions, a bacterial cell divides (grows) every 20-30 minutes in a logarithmic rate.
- BUT...in many cases, the offending microorganism needs only to survive and not multiply.
- If disease-causing microorganisms are present in the food, the food is unsafe and may cause foodborne illness.



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
What is Foodborne Illness?

...results when food contaminated with a pathogen that survives at levels sufficient to cause illness when eaten.



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Types of Foodborne illness

- **Infections:** caused by ingestion of **live** organisms 
 - e.g., Salmonellosis
 - In 12-48 hr for 2-6 days even among the healthy, symptoms include nausea, vomiting, abdominal cramps, diarrhea, fever, headache
- **Intoxications:** caused by ingestion of **preformed toxins** 
 - e.g., Staphylococcal poisoning

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Trends Affecting Frequency Foodborne Illness

- **Centralization of food production**
 - Affects both large and small food establishments
 - My reason for not encouraging small businesses to seek exemptions from regulations
- **Increase in imported food and ingredients**
 - ~15% of the total US food supply is imported
 - ~80% of seafood
 - ~50-60% of fresh produce

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When Food is Contaminated, Adulterated, or Misbranded ...

- The food is **recalled** → pulled from the market by the processor and its representatives, and its commercial distribution is stopped.
 - Remains a voluntary action under FSMA but food regulators now have the authority to mandate a recall.



Source:
[http://www.drugdangers.com/news/04/02/2015/zimmer-issues-class-2-recall-for-persona-trabecular-metal-tibial-knee-implant](http://www.drug dangers.com/news/04/02/2015/zimmer-issues-class-2-recall-for-persona-trabecular-metal-tibial-knee-implant)



Macadamia Nut Recalls in 2015



- **February 3, 2015:** Whole Foods from Whole Foods Market (raw Macadamia nuts)
- **March 21, 2015:** Nature's Eats from Texas Star Nut and Food Co. Inc. (Macadamia nuts)
- **April 3, 2015:** Peterson's from Kanan Enterprises (Macadamia nuts)
- **April 7, 2015:** Nature's Eats and Central Market from Texas Star Nut and Food Co., Inc. (Macadamia nut products)



Macadamia Nut Recalls in 2015 (cont'd)




- **April 9, 2015:** Texas Pecan Company, Inc. from Texas Pecan Company, Inc. (Macadamia nuts)
- **April 17, 2015:** Whole Foods Market from Whole Foods Market (Macadamia nuts)
- **May 15, 2015:** Aurora Natural Brand and Private Label Brands: Belmont Market, Citarella, Ernest & Klein, Gourmet Garage, Harvest Co-Op Market, Le District, Lees, Palmers Market, Water Stewart, Whole Foods Market and Wild by Nature from Aurora Products, Inc. (raw Macadamia nuts)




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Macadamia Nut Recalls in 2015 (cont'd) 

- **May 27, 2015** and **June 10, 2015**: Natural Grocers from Vitamin Cottage Natural Food Markets, Inc. (raw Macadamia nuts)
- **June 25, 2015**: Whole Foods Market from Whole Foods Market (raw Macadamia nuts)
- **June 29, 2015**: Free Range Snack Co. from Rocky Mountain Foods, Inc./Various Brands (Island Fruit and Nut Trail Mix/Bulk Macadamia Nuts)


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Macadamia Nut Recalls in 2015 (cont'd) 

- **August 5, 2015**: Izzie Macs! From Mahina Mele Farms (salted, unsalted, wholes and pieces Macadamia nuts), and Nut "Buttah"
- **August 25, 2015**: Jansal Valley from Sid Wainer and Son (raw Macadamia nuts)
- **September 2, 2015**: Sincerely from Sincerely Nuts Inc. (raw Macadamia nuts)

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SALMONELLA OUTBREAKS

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What is a Foodborne Outbreak?

An incident in which **two or more** experience a **similar illness** from ingesting a **common food** that is implicated by epidemiologic analysis as the source of illness, except for *single-incidence botulism* and *chemical poisoning*.



Source:
<http://www.pritzkerlaw.com/personal-injury/tag/restaurant-food-poisoning/>

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Significant *Salmonella* Outbreaks of Low Moisture Foods

- 2015: macadamia nuts
- 2009: pistachios (not historically associated)
- 2008-2009: peanuts and peanut products
- 2006-2007: peanut butter
- Raw almonds



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Significant *Salmonella* Outbreaks of Low Moisture Foods (cont'd)



- Snacks
- Milk powder
- Toasted oats cereal
- Chocolate
- Powdered infant formula
- Infant cereals

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High Profile Nut Outbreaks

- Peter Pan and Great Value Peanut Butter, *Salmonella* Tennessee (47 states, February-May 2007, no deaths)
 - From animal feces in the water that leaked from the roof
 - *Salmonella* can survive high processing temperatures (>158F, >70C) in a **high fat, low water activity environment** such as peanut butter, even in a dry environment.
 - No contamination must occur after heat processing of peanuts → need effective preventive controls.




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High Profile Nut Outbreaks

(cont'd)

- Processed peanuts (peanut butter, peanut paste), *Salmonella* Typhimurium (September 2008-March 2009, >2,833 peanut-containing products, 9 deaths)
 - Produced by Peanut Corporation of America (PCA) and used in many peanut and peanut-containing products
 - Insanitary plant sanitation conditions; inadequate precautions to keep rodents and insects out of its Georgia plant
 - Aflatoxin level exceeded allowable limit (20 ppb except milk)
 - PCA declared bankruptcy in February 2009.
 - As of 2011, was the largest recall in the US.




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High Profile Nut Outbreaks

(cont'd)

- On 2/21/13, former owner Steve Parnell, his brother Michael Parnell, and several employees were handed a 76-count indictment of fraud, conspiracy, and obstruction of justice.
 - They produced fake lab certificates.
 - Lied to the FDA.
 - Lied to customers regarding status of salmonella detection in PCA roasting facilities.
 - Shipped product that tested positive with *Salmonella*




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High Profile Nut Outbreaks (cont'd)




- On 9/21/15, PCA CEO Steve Parnell was sentenced to 28 years in prison, his brother Michael Parnell to 20 years, former QA Manager Mary Wilkerson to 5 years, Executives Samuel Lightsey to 3 years and Daniel Kilgore found to 6 years ("unprecedented," "historic" for a food-poisoning case)
 - Parnell's supervisory role: owner and one-time CEO of PCA
 - Combination of costly recalls: over \$100 million losses to 31 corporate victims
 - A large number of victims: >700 confirmed *Salmonella* cases, deaths, >20,000 became ill, 9 deaths




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Other High Profile *Salmonella* Outbreaks




- Con Agra frozen beef, chicken, and turkey pot pies, *Salmonella* 14,5,12:- (January-October 2007, 41 states, 165 cases, no deaths)
 - ~2 years worth of production!
 - Clear labeling is needed:
 - To state that frozen pot pie is NOT a ready-to-eat food
 - To include complete cooking instructions (for microwave and conventional ovens); use only **validated** times
 - Microwave cooking was believed to be part of the cause.





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Other High Profile *Salmonella* Outbreaks (cont'd)



- Jalapeño and Serrano peppers *Salmonella* Saintpaul (mistakenly implicated tomatoes in the beginning, April-July 2008, 43 states, at least 2 deaths)
 - Many states did not participate in the national outbreak surveillance and there was no requirement for isolate submissions
 - Huge losses by Florida and other tomato farmers who were unable to sell their products




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Other High Profile *Salmonella* Outbreaks (cont'd)






- Iowa Hillandale Farms and Wright County shell eggs, *Salmonella* Enteritides (half a billion eggs, May-November 2010, 1,939 illnesses)
 - *Salmonella* is not passed among chickens.
 - This is a rodent problem → Chickens may come in contact with rodent droppings .
 - *Salmonella* is then passed to chicken ovaries, then chicken eggs.
 - Approximately 1 in 5,000 chicken carries *Salmonella* but is unaffected by the organism
 - USDA graders are in the facility every day



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\$ Losses to the Food Industry Due to *Salmonella*

Produce	Est. Revenue Loss
2008 Jalapeño & serrano Peppers <i>Salmonella</i> Saintpaul	\$450 million to producers 
2009 Peanut products <i>Salmonella</i> Typhimurium	\$1 billion to growers 
2010 Shell eggs <i>Salmonella</i> Enteritides	500 million eggs 



Source: <http://www.ombwatch.org/node/11543>. (Accessed January 31, 2012)

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Just Happened → *Salmonella* Outbreak



- *Salmonella* Poona from “Limited Edition” cucumbers from Mexico imported by Andrew & Williamson Fresh Produce (A&W)
 - As of 10/8/15, there were 732 cases, 150 hospitalizations, and 4 deaths from 35 states
 - 50% <18 years old
 - Recalled on 9/4/15
 - 14-day shelf life
 - First lawsuit filed on 9/7/15


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SALMONELLA AND NUTS




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Why *Salmonella* in Nuts?




- Potential presence in raw nuts
 - Nature of nut cultivation and harvesting
 - Survival of *Salmonella* in **dry** environments and products (increased heat resistance at low moisture)
 - Not eliminated during refrigeration, freezing, or drying
- Needs only to be present to cause an illness (**does not need to multiply in low-moisture foods**)




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Why *Salmonella* in Nuts? (cont'd)



- Ubiquitous: One of the most common and widely distributed micro-organisms worldwide.
- Hardy: known to survive in both dry and wet environments
- Generally accepted as the **most resistant pathogen** for low moisture foods **at this time** (desiccation, tolerance, history, epidemiology)



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Why *Salmonella* in Nuts? (cont'd)

- More resistant than *E coli* O157:H7
 - Desiccation
 - Heating in oil at 121C (250F), 1 min
 - Dry heating (lab) at 135C (275F), 40 min
- Heat resistance is significantly impacted by
 - a_w (the lower the a_w , the more heat resistant)
 - Nut type, size, shape
 - Composition (fat, protein, carbohydrates)
 - Shell, skin



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Please Remember That...

- Washing does not eliminate pathogens.
- Therefore,
 - Prevent microbial contamination
 - Reduce sources of microbial contamination
 - Train personnel to look at the field and farm as a kitchen facility
 - Educate, educate, educate



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CONTROL OF SALMONELLA

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Control of ~~Salmonella~~ in Nuts

Through a food safety plan for all nut *products* and *processes* (as per FSMA)


- Commonly, **HACCP** which is a management tool to
 - Prevent
 - Eliminate
 - Reduce food safety risks to an acceptable level



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Control of ~~Salmonella~~ in Nuts (cont'd)

- Reviewed at a defined frequency by
 - Internal auditors
 - Third-party auditors
- Prerequisite Programs in place that are verified and documented




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Control of ~~Salmonella~~ in Nuts (cont'd)


Prerequisite Programs

• Facilities	• Pest control
• Personnel	• Allergen management
• Production equipment	• Extraneous matter control
• Control of raw materials	• Receiving, storage, distribution
• Sanitation	• Product tracing and recall
• Primary Salmonella Control Area (PSCA)	• Hold and release
• Pathogen environmental monitoring program (PEMP)	• Lab operations
• Training	







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**Control of *Salmonella* in Nuts (cont'd)**

- Allergen management
 - Avoiding allergens
 - Minimizing cross-contact with undeclared allergens
 - Label controls
- Equipment sanitary design and installation for low-moisture foods


Source: <http://www.al-aware.com/standard-samples.html>




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**Control of *Salmonella* in Nuts (cont'd)**

- Preventive Controls
 - Food/Ingredient
 - Nuts
 - Salt
 - Seasonings
 - Process
 - Dehydration
 - Roasting (oil, dry)
 - PPO
 - Equipment: dehydrators, PPO chambers, roasters

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**Control of *Salmonella* in Nuts (cont'd)**

- FSMA increased
 - Awareness and mandated good practices for ALL groups involved in the food supply
 - Testing by groups that traditionally didn't test as often: purchasing, distributors, re-sale

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Control of *Salmonella* in Nuts (cont'd)


- Identification of Primary *Salmonella* Control Area (PSCA) = hygiene zoning
 - Prevents cross contamination via highest level of hygiene control, including
 - Structural barriers
 - Traffic flow
 - Air filtration
 - Sanitation (dry)



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Control of *Salmonella* in Nuts (cont'd)


- Pathogen Environmental Monitoring Program (PEMP) to verify effectiveness of *Salmonella* control program
 - On **non-product** contact surfaces during operation
 - On **product** contact surfaces at other conditions (e.g., upon installation of new equipment, as part of corrective actions)



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Control of *Salmonella* in Nuts (cont'd)

- Bioterrorism Act of 2002 requires all companies to register with the FDA
 - Food defense plan to prevent intentional contamination
 - Limit access to production
 - Background checks for employees
 - Tamper-resistant packaging



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Control of *Salmonella* in Nuts (cont'd)

- Various processing technologies
 - Thermal roasting
 - Dry roasting
 - Oil roasting
 - Steam or hot water treatment followed by drying
 - Non-thermal treatment (e.g., chemical processing using PPO)
 - Propylene oxide (PPO): not approved for peanuts
 - Ethylene oxide: for black walnuts only

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Control of *Salmonella* in Nuts (cont'd)

- Since *Salmonella* is more heat resistant in low moisture foods
 - Use of moist air (5-90% RH) convection heating was successfully applied to raw almonds for pasteurization (Jeong, Marks, and Orta-Ramirez, 2009)
 - Surface moisture status of the almonds was most important factor in effective pasteurization, not RH of the air

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Control of *Salmonella* in Nuts (cont'd)

- Validation studies on these technologies must demonstrate achieving a minimum degree of lethality through
 - Inoculation challenge study of the appropriate *Salmonella* strains or surrogate organism or
 - Measurement of the physical delivery of the process in operation
- Validation of processes
 - Part of HACCP
 - Part of Preventive Controls

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Control of *Salmonella* in Nuts (cont'd)

- In the absence of any data to establish a target log reduction, a **5-log** reduction is science-based and appropriate.


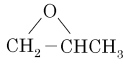

100,000 cells reduced to 1
100,000 times smaller than before



UPDATE!

PPO Experiment (OSU, UC Davis)


- Boxes of nuts were stacked on a pallet
 - Bottom: hazelnut kernels
 - Middle: hazelnuts in-shell
 - Top: macadamia kernels, macadamia in-shell
 - One bag standing on the side: hazelnut
 - One bag on top of the macadamia nut: hazelnut
- Pallets were gassed with PPO
- Gassed pallets compared to control



UPDATE!

PPO Experiment (OSU, UC Davis) (cont'd)

- Results
 - PPO parameters used were insufficient to reduce contamination on the macadamia nuts to an acceptable level
 - Unexplained parameters that need additional trials
 - Chamber issue (mixing of gases)
 - Stacking of nuts on the pallet (height of the stack)



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UPDATE!

PPO Experiment (OSU, UC Davis) (cont'd)


- Still to be done: additional PPO trials
 - November experiment is scheduled
 - Researchers at OSU and UC Davis will be asking monetary contributions of about \$2,000 per interested party to continue participation

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UPDATE!


PPO Experiment (OSU, UC Davis) (cont'd)

- Still to be done: Validation of roasting
 - Actual inoculation and destruction of target organism (or surrogate)
 - Review of the roasting process
- Even if there is a regulatory requirement, conducting a risk assessment to determine if the requirement is **appropriate** for your facility may be prudent.

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References

- GMA Nut Safety Task Force. 2010. Industry Handbook for Safe Processing of Nuts. http://www.gmaonline.org/downloads/technical-guidance-and-tools/Industry_Handbook_for_Safe_Processing_of_Nuts_1st_Edition_22Feb10.pdf
- GMA. February 4, 2009. Annex to Control of *Salmonella* in Low-Moisture Foods. <http://www.gmaonline.org/downloads/wygwam/Salmonellaguidanceannex.pdf>

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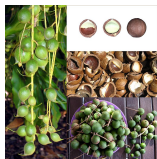
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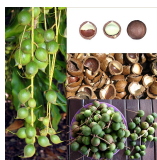
- Harris, Linda J. April 2, 2014. Validation: Pathogen-Reduction Steps. <http://ucfoodsafety.ucdavis.edu/files/188619.pdf>
- Harris, Linda. J. (Ed.). 2013. Improving the safety and quality of nuts. Woodhead Publishing Series in Food Science, Technology and Nutrition: Number 250. Woodhead Publishing Ltd., Cambridge, UK.
- Jeong, S., Marks, B. P., & Orta-Ramirez, A. (2009). Thermal inactivation kinetics for *Salmonella* Enteritidis PT30 on almonds subjected to moist-air convection heating. Journal of Food Protection, 72: 1602–1609.





QUESTIONS?





Thank you!

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