Food Safety Across the Supply Chain – Keeping Your Foot on the Gas

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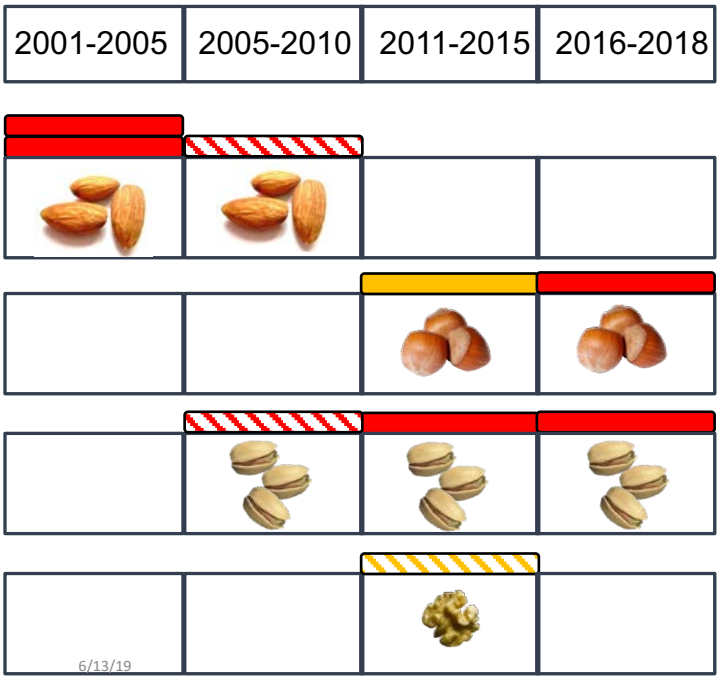
WESTERN CENTER for FOOD SAFETY UCDAVIS



Foodborne Outbreaks Linked to U.S. Grown Tree Nuts

Salmonella
***E. coli* O157:H7**

Dashed lines = weaker epidemiology

Foodborne Outbreaks Linked to California Grown Almonds

Salmonella

Dashed lines = weaker epidemiology

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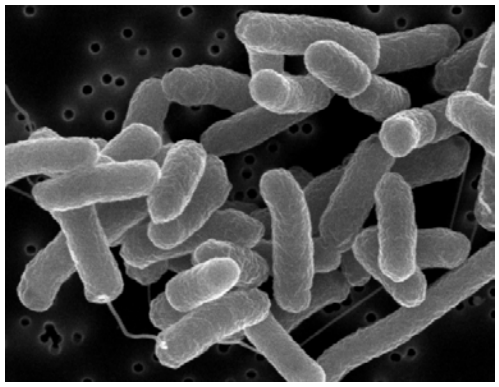

Salmonella Enteritidis Phage Type 30

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Salmonella Enteritidis Phage Type 30

2001 outbreak investigation

Retail Raw Almonds

Handler

Huller/ Sheller

Grower

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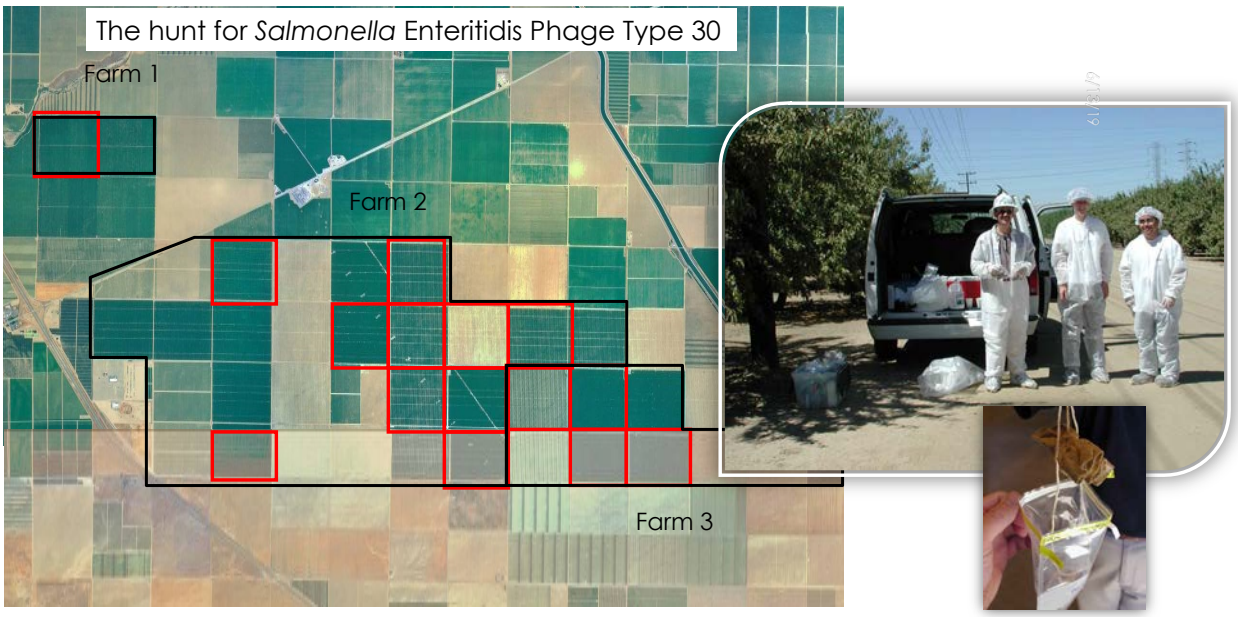
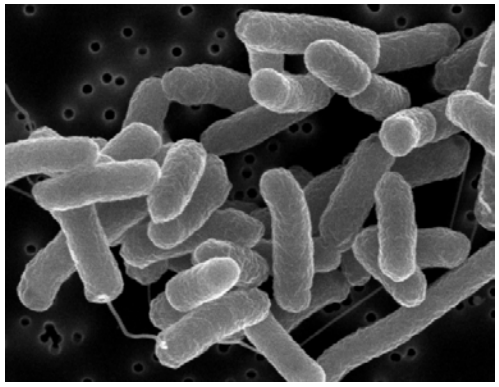
2001 15 of 32 - 150 acre orchards positive SEPT30- 10 sq miles

Origin of *Salmonella* Enteritidis PT 30 never identified





Salmonella Enteritidis Phage Type 30

Harris Lab → UCD Lab San Bernardino → USDA Lab Nebraska

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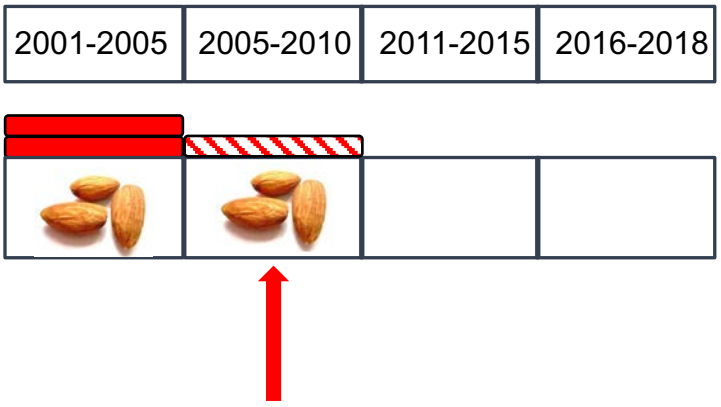

September 1, 2007
Implement Mandatory Treatment Process
4-log reduction of *Salmonella*
7 CFR Part 981.442b

Foodborne Outbreaks Linked to California Grown Almonds

Salmonella

Dashed lines = weaker epidemiology

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Why
4 log (100,000-fold) reduction?

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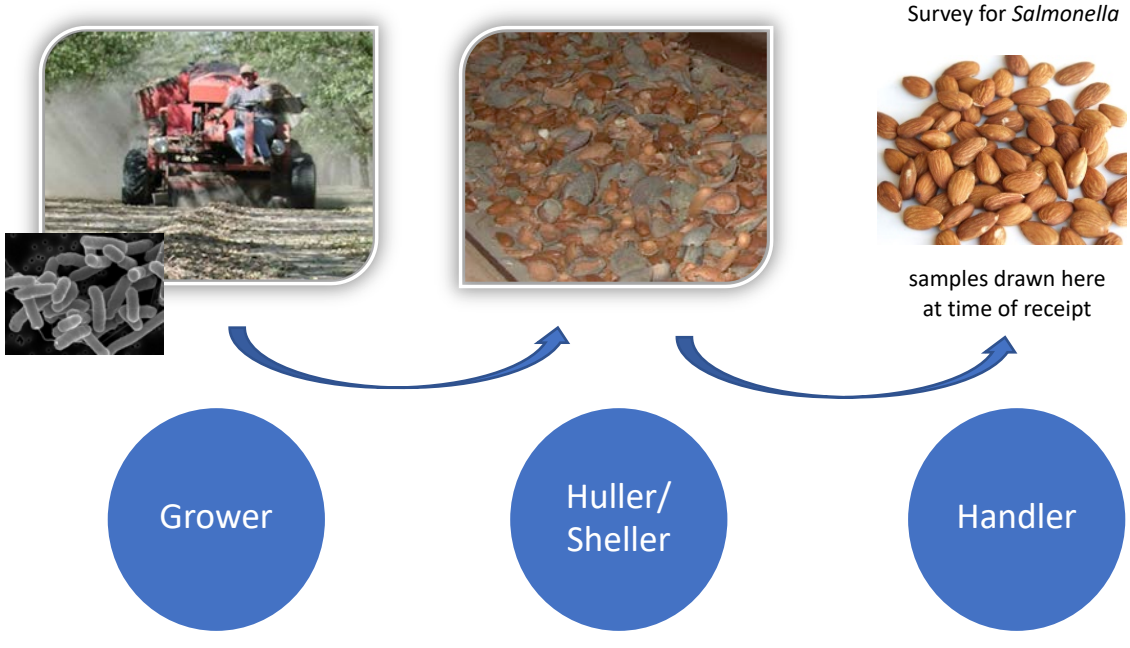

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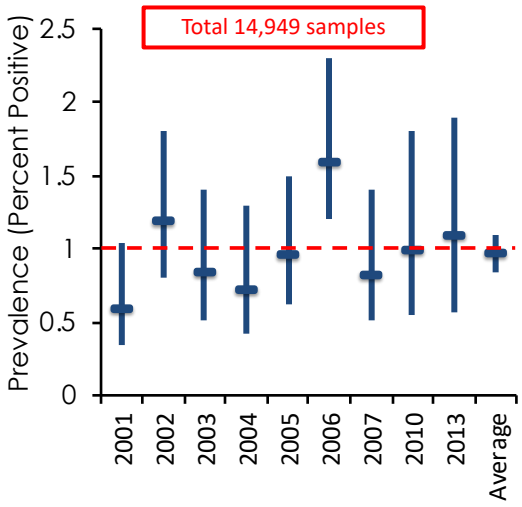
Prevalence of *Salmonella* in 100-g Raw Almond Kernels With 95% CI



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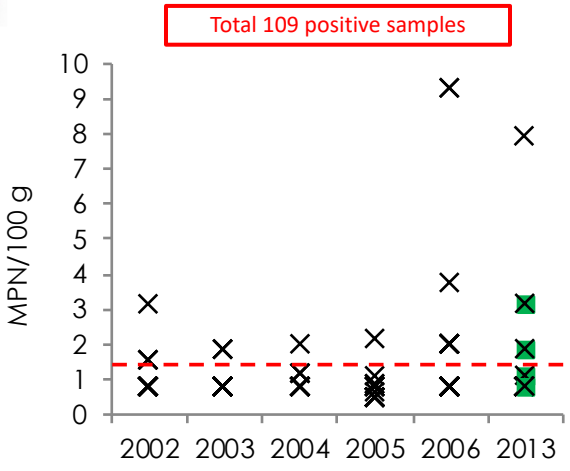
Average ~1% positive

Levels of *Salmonella* in almonds per 100 g



Average – 1.3 ± 1.4 MPN/100 g

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1% Prevalence of *Salmonella* in 100-g Raw Almond Kernels

Based on 14,949 samples over 9 years

~15,000 * 100 = 1,500,000 g = 3,300 lbs = total amount sampled

~10,600,000,000 lbs produced in those 9 years

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Danyluk et al., 2006

Journal of Food Protection, Vol. 69, No. 7, 2006, Pages 1594–1599

Monte Carlo Simulations Assessing the Risk of Salmonellosis from Consumption of Almonds

MICHELLE D. DANYLUK,[1] LINDA J. HARRIS,[1]* AND DONALD W. SCHAFFNER[2]

First Risk Assessment

Helped Almond Board Management Decision
to set
4-log reduction of *Salmonella* in almonds
7 CFR 981.442(b)

Note: log = logarithm

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Lambertini et al., 2012

Food Research International 45 (2012) 1166–1174

Contents lists available at ScienceDirect

Food Research International

journal homepage: www.elsevier.com/locate/foodres

Risk of salmonellosis from consumption of almonds in the North American market

Elisabetta Lambertini [a], Michelle D. Danyluk [b], Donald W. Schaffner [c], Carl K. Winter [a], Linda J. Harris [a,*]

Second Risk Assessment

- Used updated data (reduced uncertainty)
- Evaluated "state of the industry"
- Evaluated ABC "pasteurization" program
- Evaluated "limits" where program might fail
- Evaluated 2000/2001 outbreak data

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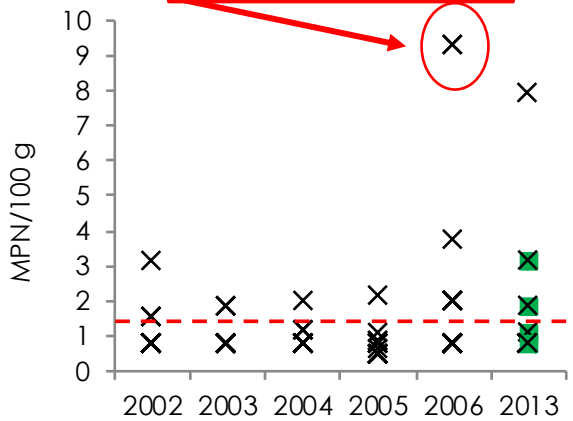
Why/When?

Levels of *Salmonella* in almonds per 100 g

Total 109 positive samples



Average – 1.3 ± 1.4 MPN/100 g

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2001 Outbreak
Est. up to 120 cells/100 g

Why?

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Salmonella serovars isolated 2001-07, 2010, and 2013

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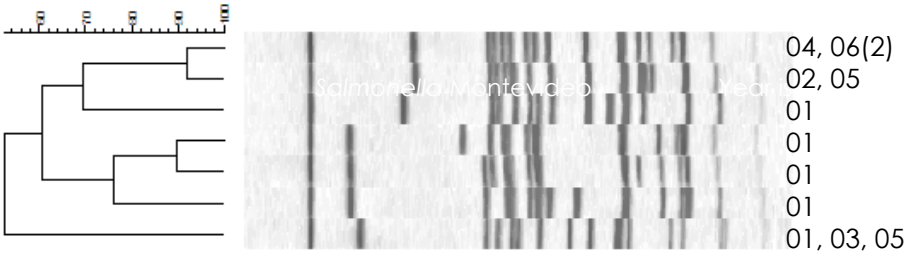
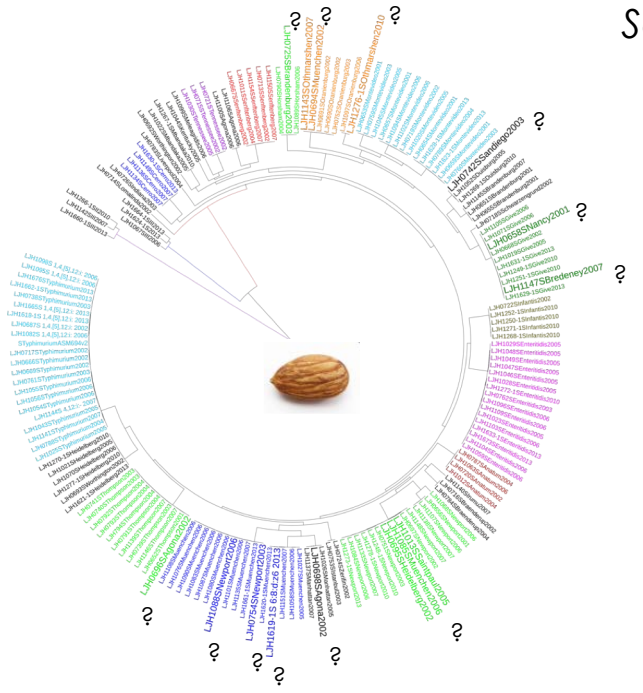
- Multiple PFGE patterns for repeat serovars





Salmonella serovars isolated 2001-07, 2010, and 2013

Whole Genome Sequence Analysis

171 isolates from almond kernels
9 year survey, ~15,000 samples

Wide range of *Salmonella* types

39 serovars
22 serovars isolated single times

Hypothesis: Contamination Source

- Evidence suggests under normal circumstances contamination on the farm is:
  - Environmental
  - Sporadic
  - Random
  - Low levels

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Why does the same serovar sometimes show up in replicate but independent samples?

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March 2019

Guidance for Industry: Enforcement Policy for Entities Growing, Harvesting, Packing, or Holding Hops, Wine Grapes, Pulse Crops, and Almonds





"We will consider revising our intent to exercise enforcement discretion if, for example, new information becomes available regarding safety concerns associated with the production and consumption of these commodities."

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7 CFR Part 981.442b – Validation September 2007

Goal is to demonstrate ability to achieve a minimum 4-log reduction (100,000-fold reduction) of *Salmonella* on almonds

Based on survey data of ~1% prevalence and low numbers

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Produce Safety Rule Enforcement Discretion

Assumes Almond Growers Follow GAPs

AND

Almond Huller/Shellers Follow GMPs

Harris opinion 6/13/19

IF there is another California almond outbreak - the cause will be:

1) Unusually high contamination of a lot during production or harvest
   - Contamination exceeds the capacity of a 4-log treatment
   - Should be addressed in grower food safety plan
   - Should be addressed in huller/sheller GMP program

2) Consumption of raw product (sold outside of North America)
   - Should be addressed in grower food safety plan
   - Should be addressed in handler food safety plan
   - Should be addressed by treatment at final destination

3) Recontamination of adequately treated product
   - Handler cross contamination
   - Should be addressed in handler food safety plan

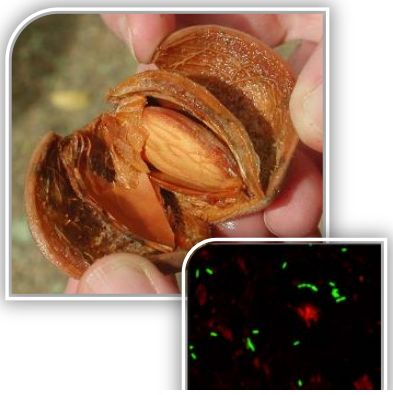
Harris Prediction 6/13/19

Avoiding High Level Contamination at the Farm Is Important

Shell is not protective in soft shell varieties

Exposed kernel

Increases in *Salmonella* are possible when almond hulls are wet



Salmonella in wet hull

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Assessing Risks Unique to Almonds

Almonds dry on the ground for 7 to 10 days

The orchard floor serves as a "food contact surface"

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Assessing Risks Unique to Almonds

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Assessing Risks Unique to Almonds

Almond Board of California "*Stockpile Management Best Practices*"

2001 to 2019

- How many more growers?
- How many more acres?
- How many more pounds?

How many understand and appreciate the basis of the current food safety practices?

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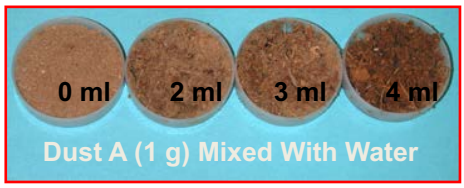
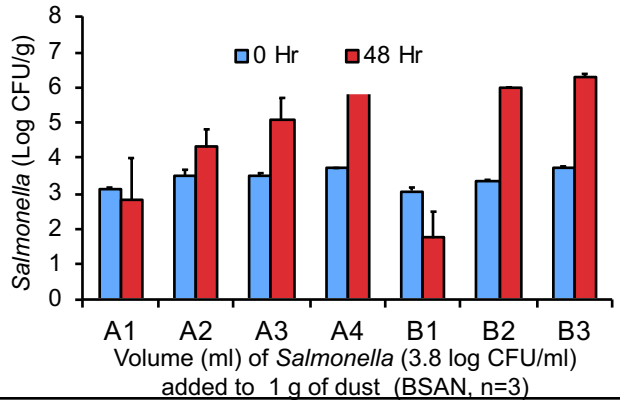
Significant Cross Contamination is Possible at Huller/Sheller

Within a Single Lot
Among Different Lots

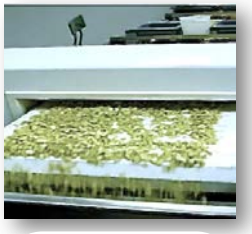
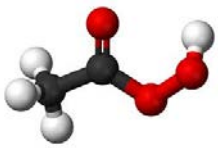
Du et al., 2010. J. Food Sci. M7-13

Salmonella Grows in Wet Almond Dust

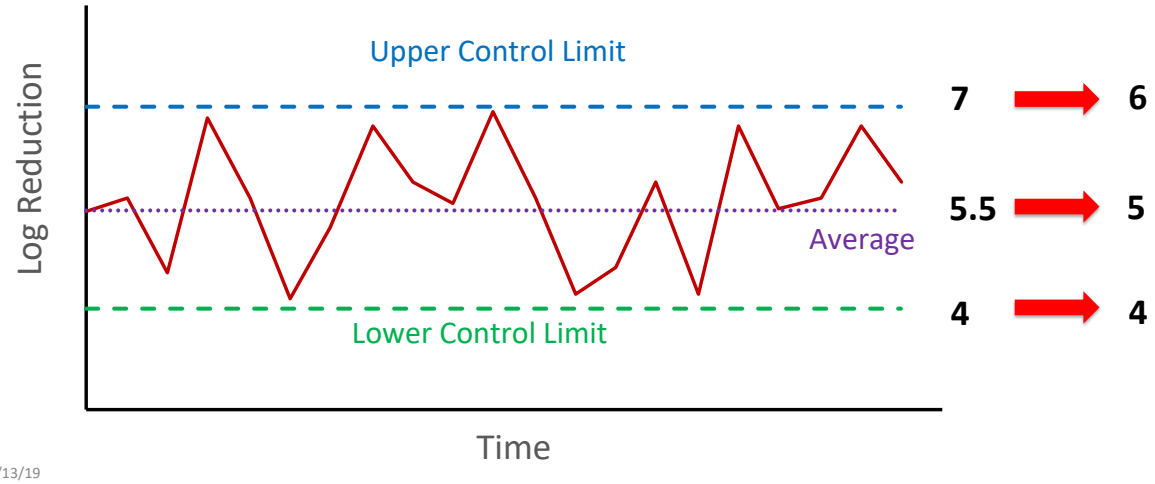




Post Harvest Treatment Options

Wet Heat	Dry Heat	Nonthermal	Gas	Other Chemical
				
Steam Water Humidity Re-wetting Vacuum	Convection Baking, Roasting, Infrared, radio frequency	Radiation, Plasma, High pressure, ??	Propylene or Ethylene Oxide, Ozone	Peracetic acid ??

What happens as we get better at hitting a target minimum 4-log reduction?



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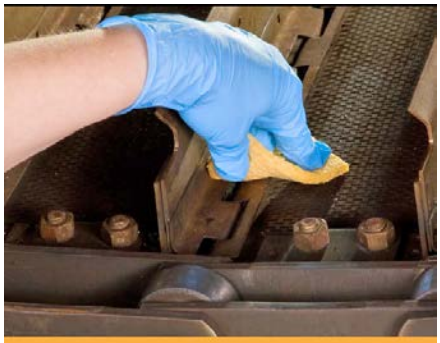
The *Salmonella* Control Equation

TRAFFIC CONTROL (PERSONNEL & EQUIPMENT)
+
DUST CONTROL
+
WATER CONTROL
+
SEPARATION OF RAW & PASTEURIZED PRODUCT
+
EFFECTIVE CLEANING & SANITATION

SALMONELLA CONTROL

Effective Pathogen Environmental Monitoring



http://www.almonds.com/processors/processing-safe-product#pem



EVERYONE PLAYS A ROLE IN FOOD SAFETY

Grower

Huller/ Sheller

Handler

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2001-2010	2011-2020	2021-2030	2031-2040
Predicting the future?			
			

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Salmonella

Dashed lines = weaker epidemiology

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