



the Almond
CONFERENCE
2019

Almond Food Safety: Past, Present and Future

 **california
almonds**[®]
Almond Board of California

Session Speakers

Tim Birmingham, ABC

Brian Dunning, Shoei Foods

Linda Harris, UC Davis



Almond Food Safety: Past, Present, and Future

Linda J. Harris, PhD CFS

Chair and Specialist in Cooperative Extension

Department of Food Science and Technology,

University of California, Davis

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12-11-19



FOOD SAFETY

PAST

PRESENT

FUTURE

2001

2019



Almond Industry

Food Industry



Technology

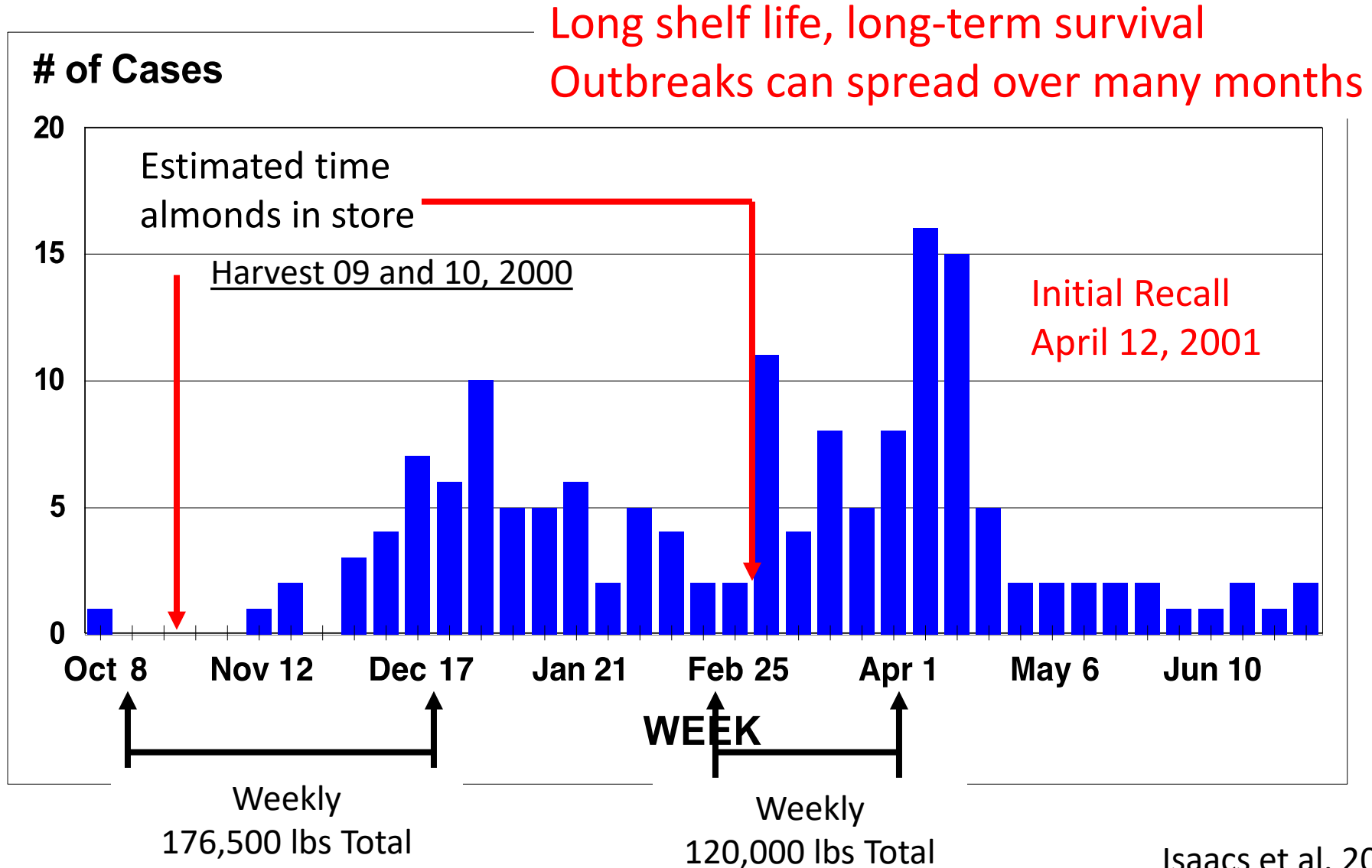
Globalization

2001

2019



2001 almond outbreak: Onset Dates of *Salmonella* Enteritidis PT30 Cases Canada/Raw Almond Shipments from California

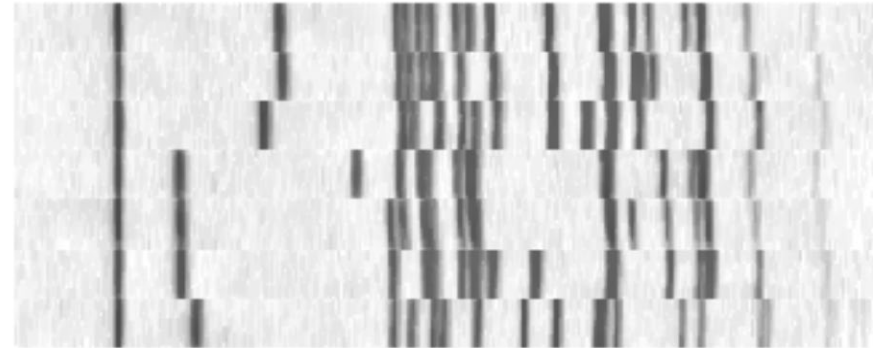
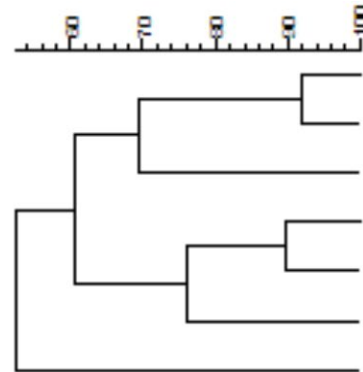




Outbreak Investigation Trends – 2001

Salmonella Phage Typing **

PFGE

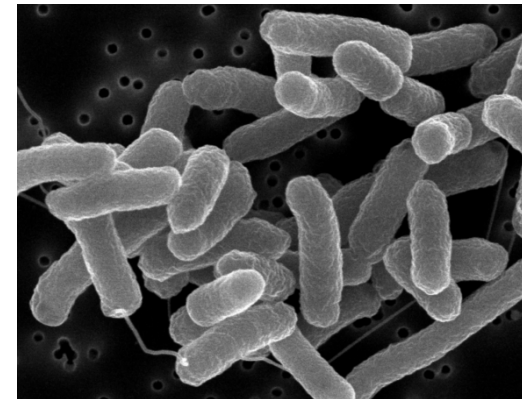


Consumer Trends – 2001

Raw Almonds

Out-of-hand consumption

Increased volume



Isolation of *Salmonella* Enteritidis Phage Type 30

2001 outbreak investigation



Retail
Raw
Almonds

Handler

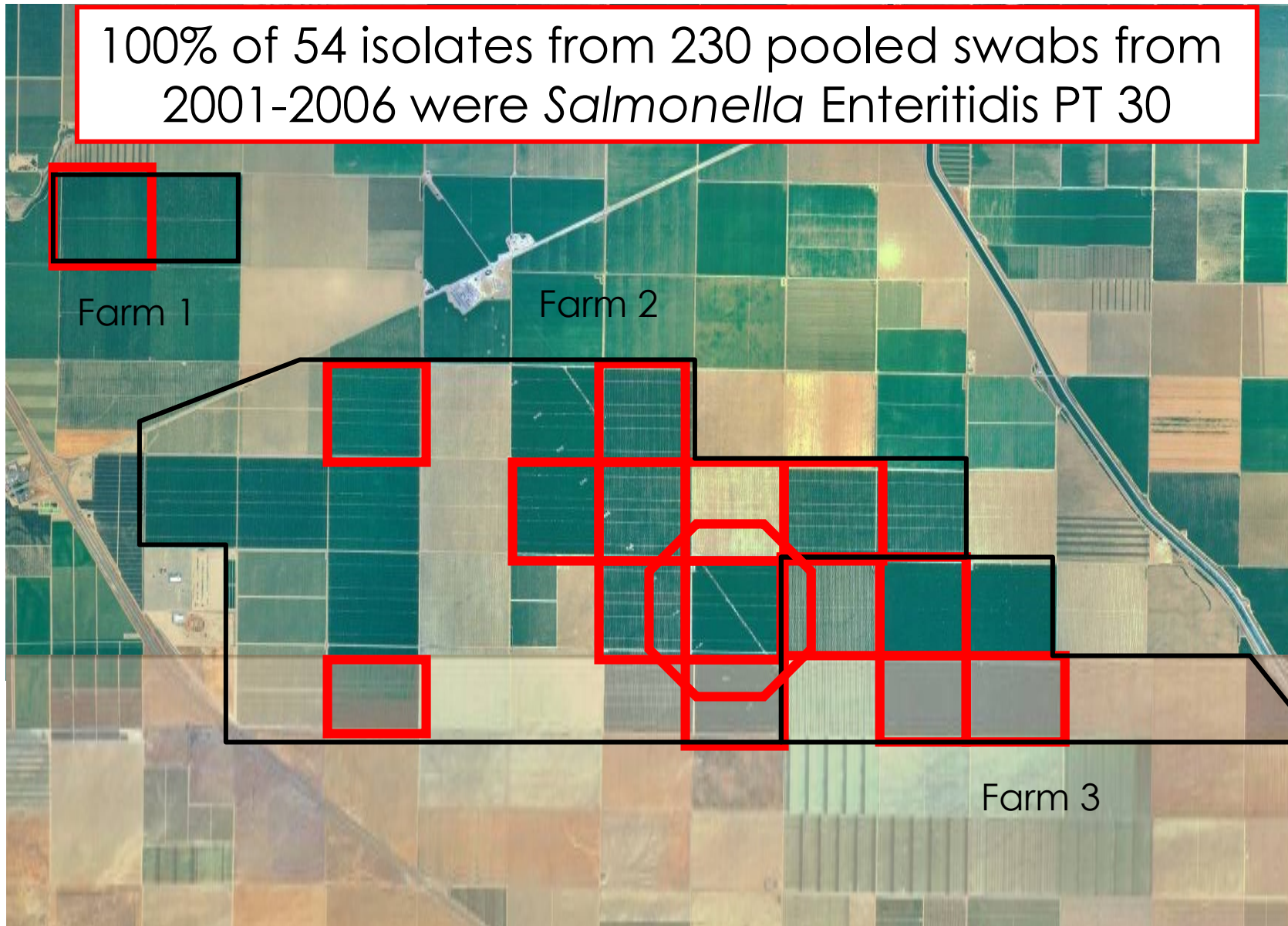
Huller/
Sheller

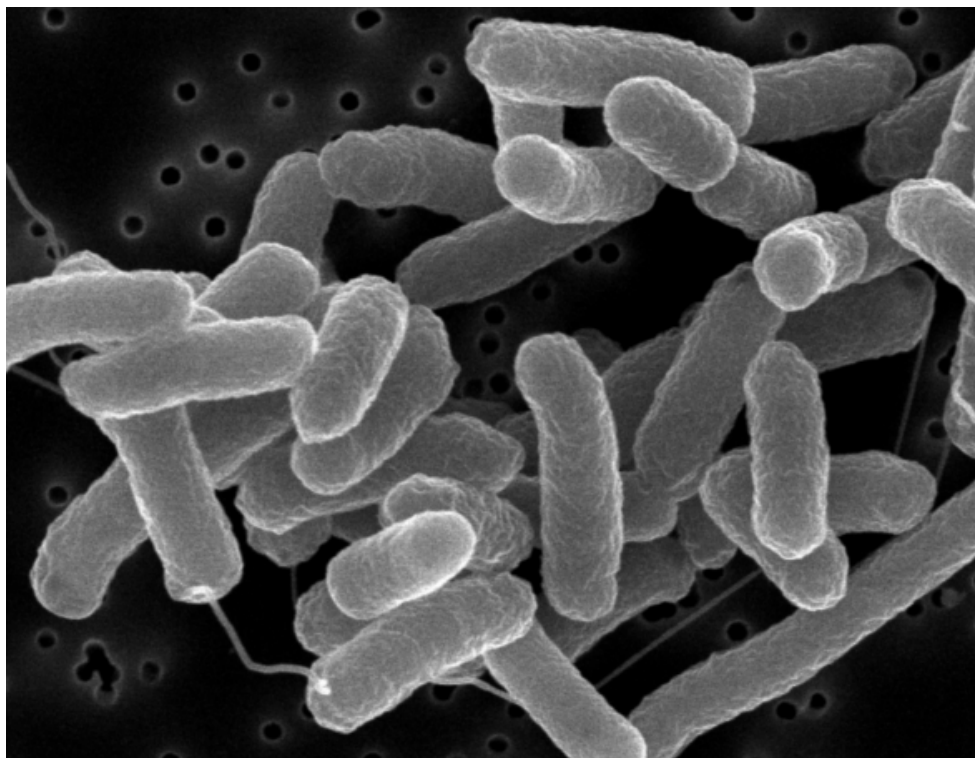
Grower

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

Origin of *Salmonella* Enteritidis PT 30 never identified

100% of 54 isolates from 230 pooled swabs from 2001-2006 were *Salmonella* Enteritidis PT 30





Salmonella Enteritidis Phage Type 30



Harris Lab



UCD Lab
San Bernardino

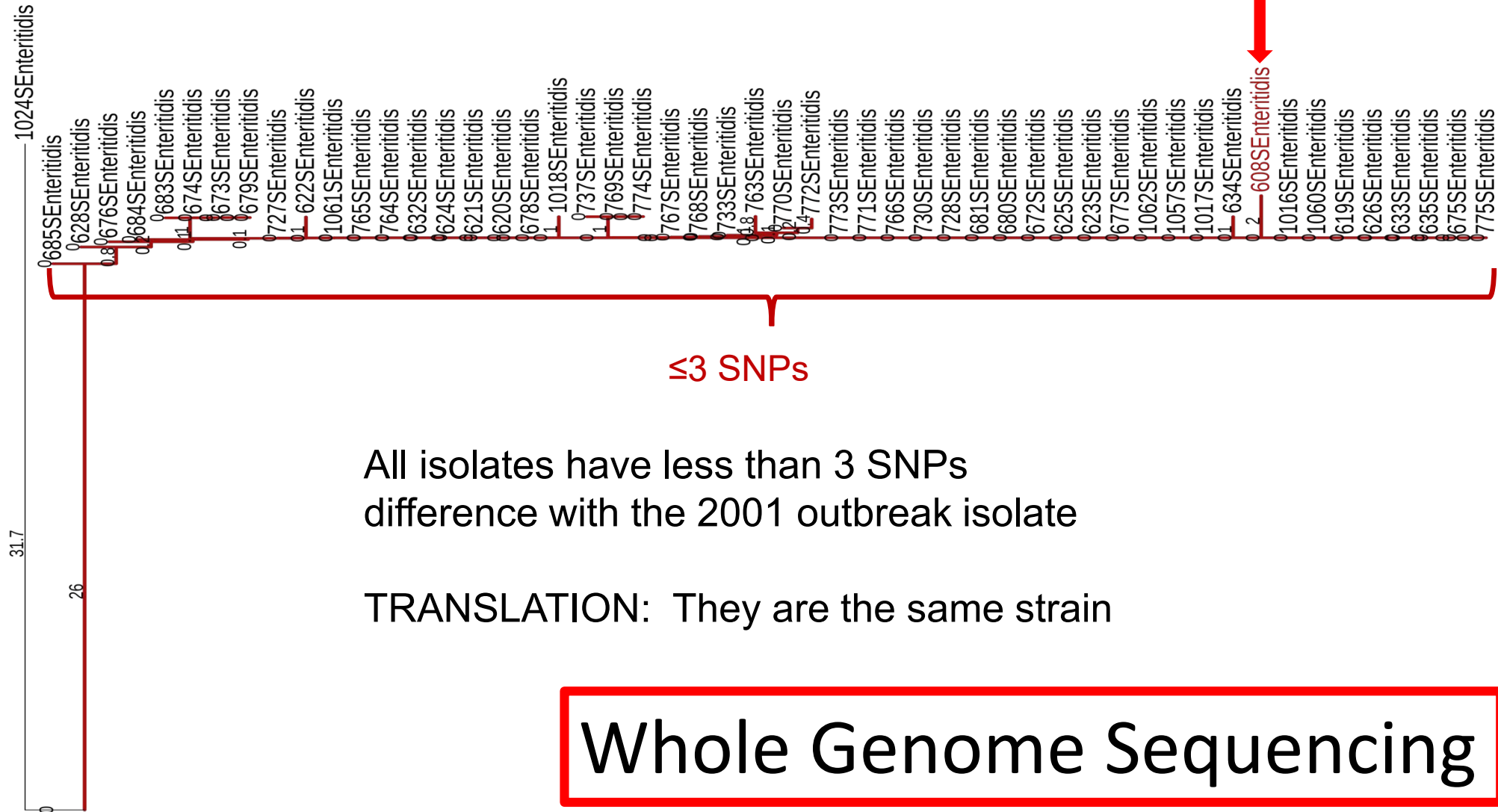


USDA Lab
Nebraska

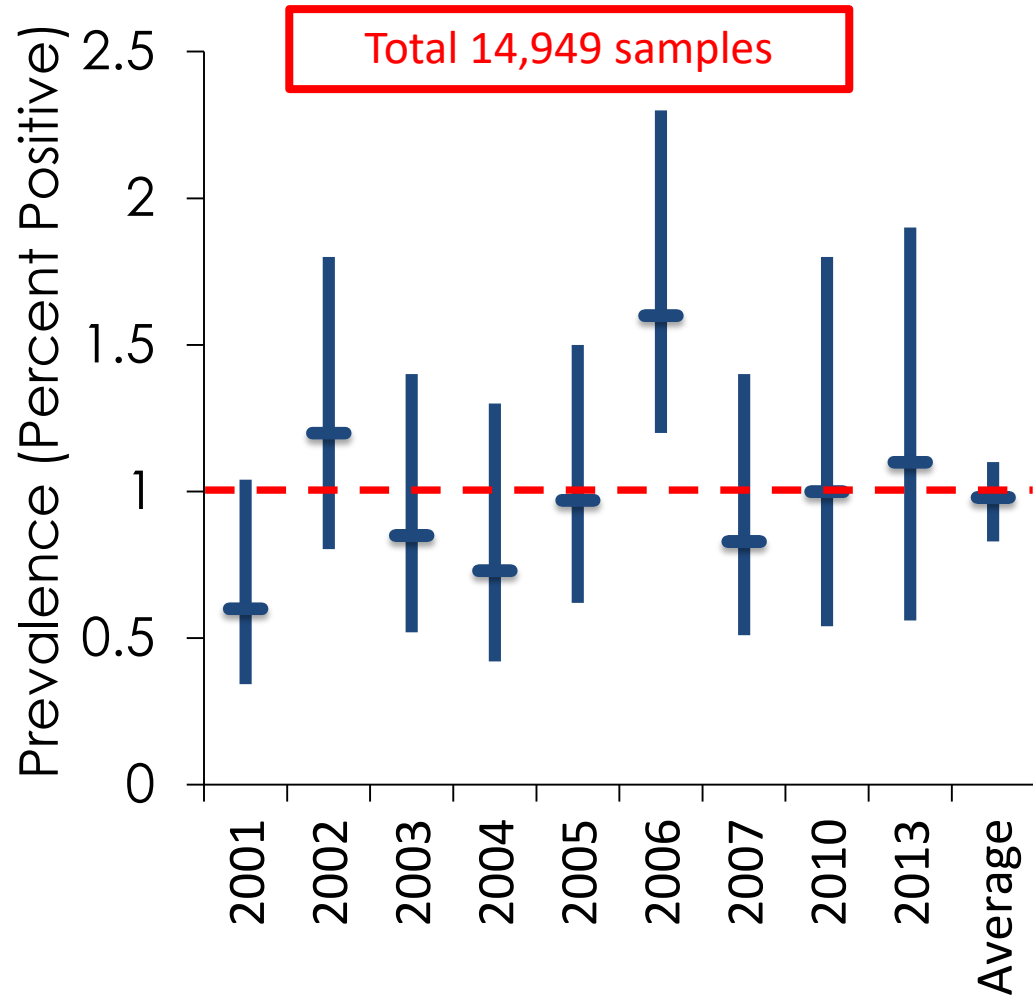
Genetic distance between *Salmonella* Enteritidis PT30 retrieved from a single orchard from 2002 to 2006

2004 outbreak

2001 outbreak

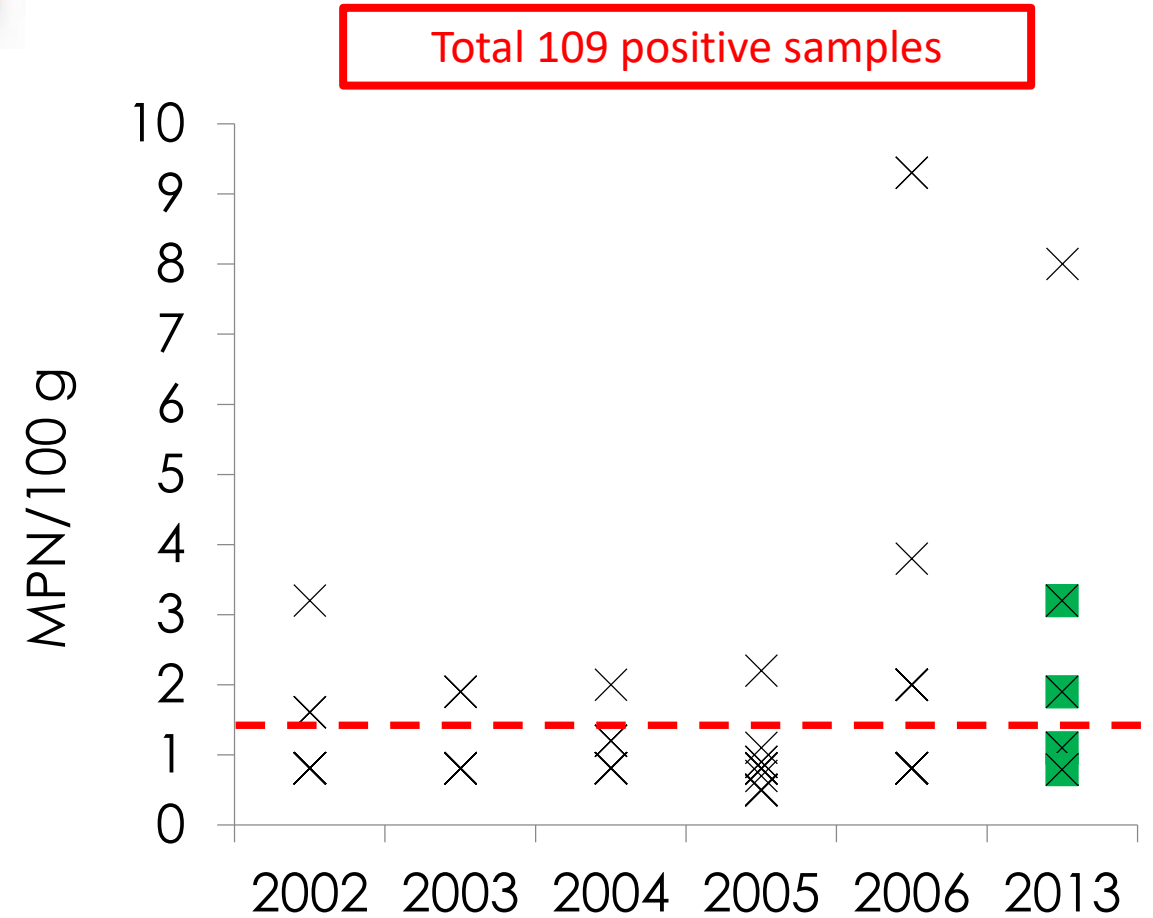


Prevalence of *Salmonella* in 100-g Raw Almond Kernels With 95% CI



Average ~1% positive

Levels of *Salmonella* in almonds per 100 g



Average - 1.3 ± 1.4 MPN/100 g

Salmonella serovars isolated 2001-07, 2010, and 2013

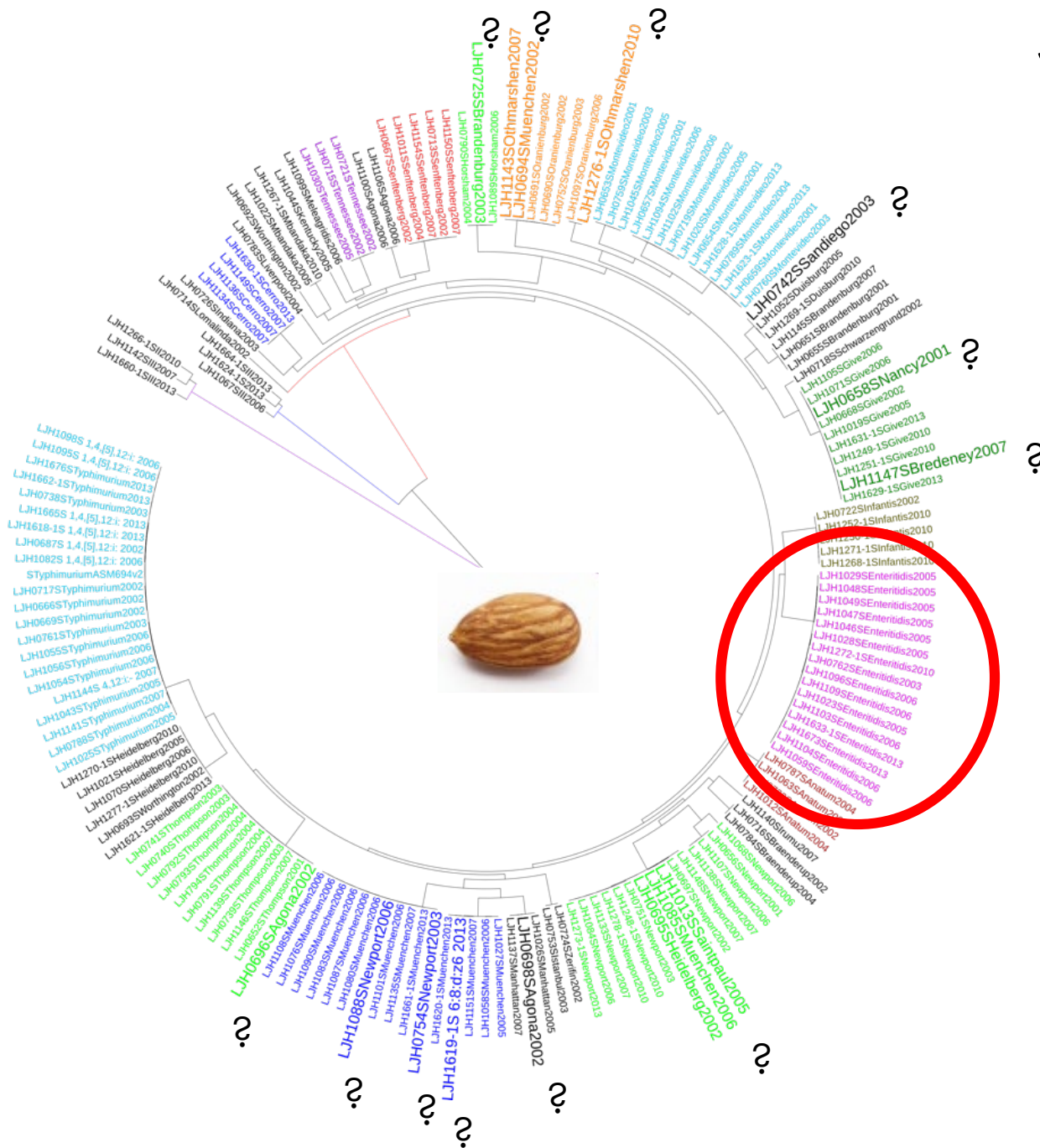
Whole Genome Sequence Analysis

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

Wide range of *Salmonella* types

39 serovars

22 serovars isolated single times

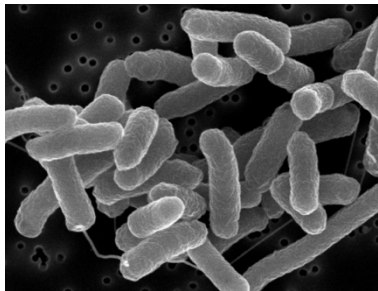




Hypothesis: Contamination Source

- Evidence suggests under normal circumstances contamination on the farm is:

- Environmental
- Sporadic
- Random
- Low levels





Why?



Clade 1: PT30
≤ 56 SNPs

2 SNPs

LJH1059SEnteritidis2006
LJH1104SEnteritidis2006
LJH1633-1SEnteritidis2013
LJH1673-1SEnteritidis2013
LJH1103SEnteritidis2006
LJH1023SEnteritidis2005
LJH608SEnteritidisPT30
LJH1096SEnteritidis2006
LJH1109SEnteritidis2006
LJH0762SEnteritidis2003

← 2001 outbreak strain

> 500 SNPs

Clade 2: PT9c
≤ 14 SNPs

LJH1028SEnteritidis2005
LJH1024SEnteritidisPT9c
LJH1272-1SEnteritidis2010

← 2004 outbreak strain


> 500 SNPs

Clade 3: PT8
≤ 3 SNPs

LJH1029SEnteritidis2005
LJH1047SEnteritidis2005
LJH1048SEnteritidis2005
LJH1046SEnteritidis2005
LJH1049SEnteritidis2005

Maximum likelihood tree based on SNPs identified in *Salmonella* Enteritidis genomes within the FDA CFSAN pipeline

FOODBORNE PATHOGENS AND DISEASE
Volume XX, Number XX, 2019
Mary Ann Liebert, Inc.
DOI: 10.1089/fpd.2019.2706



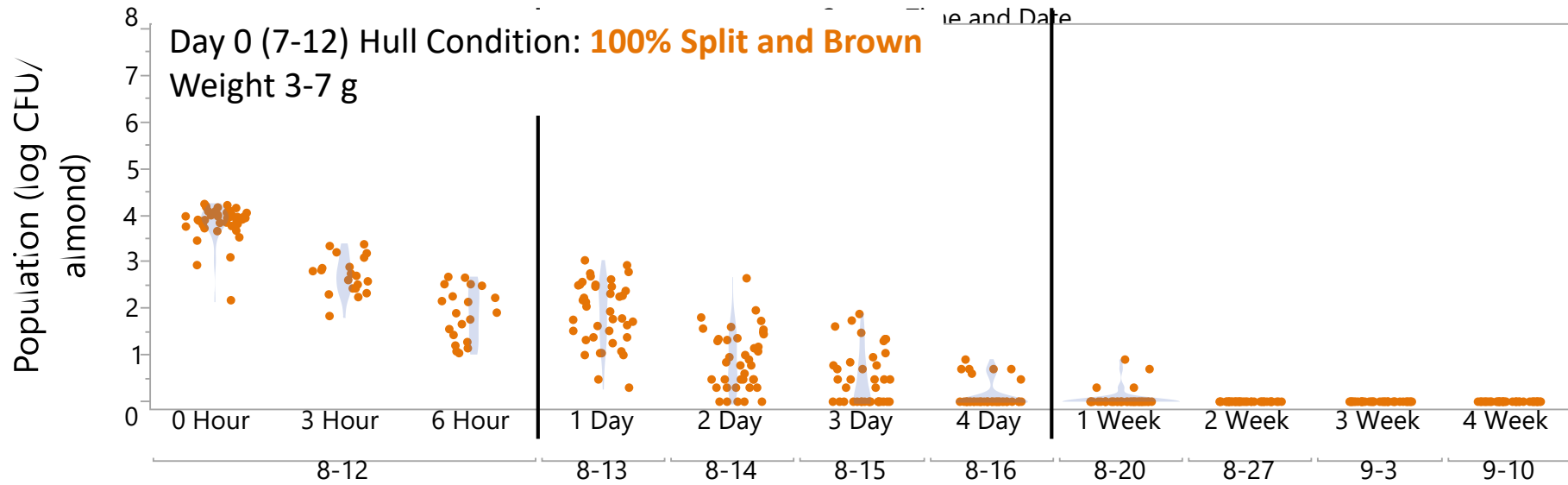
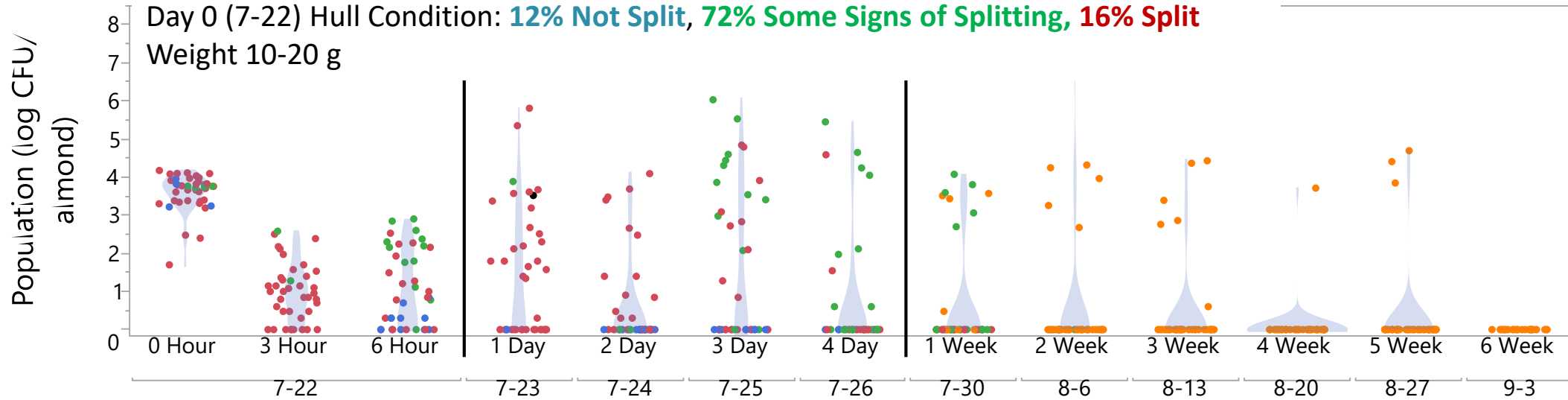
Source Attribution of *Salmonella* in Macadamia Nuts to Animal and Environmental Reservoirs in Queensland, Australia

Nanna Munck,¹ James Smith,² John Bates,³ Kathryn Glass,⁴ Tine Hald,¹ and Martyn D. Kirk⁴

Agricultural Water Quality Produce Safety Rule



Combined Almond Inoculations (Inoculation Days 7-22-2019, 8-12-2019)

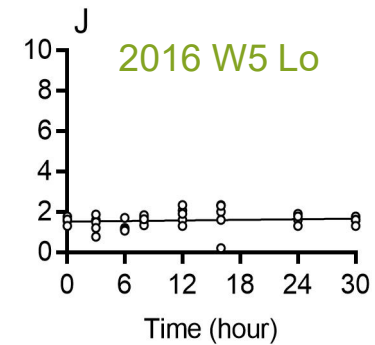
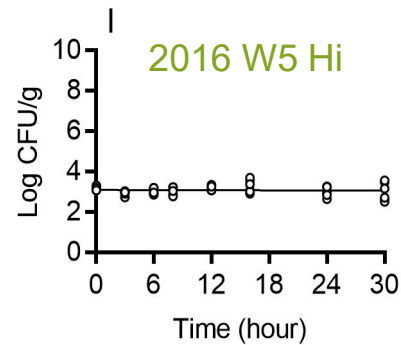
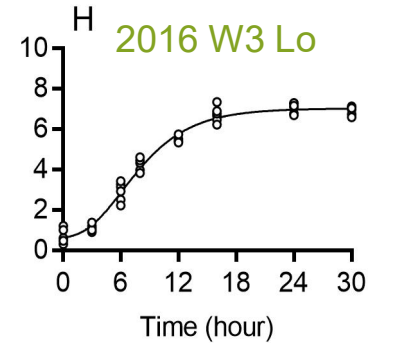
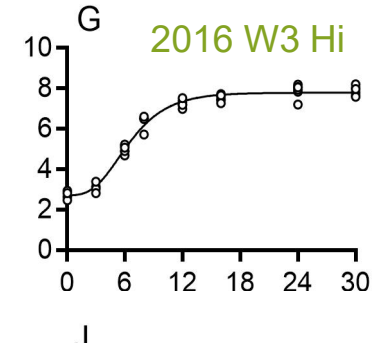
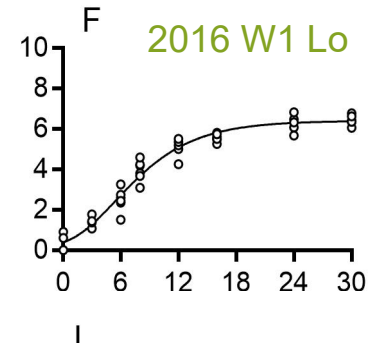
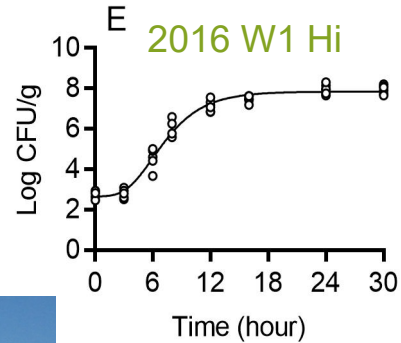
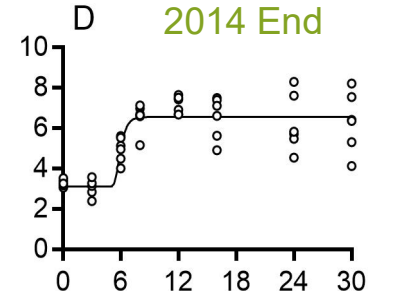
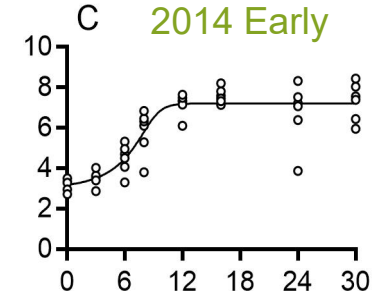
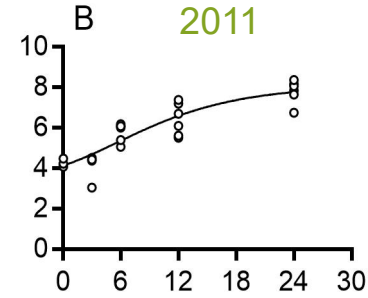
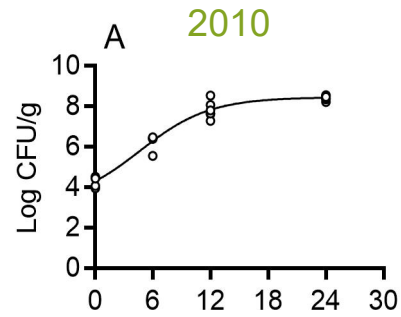


Sample Time and Date

Changes in Harvest Practices – What Impact?

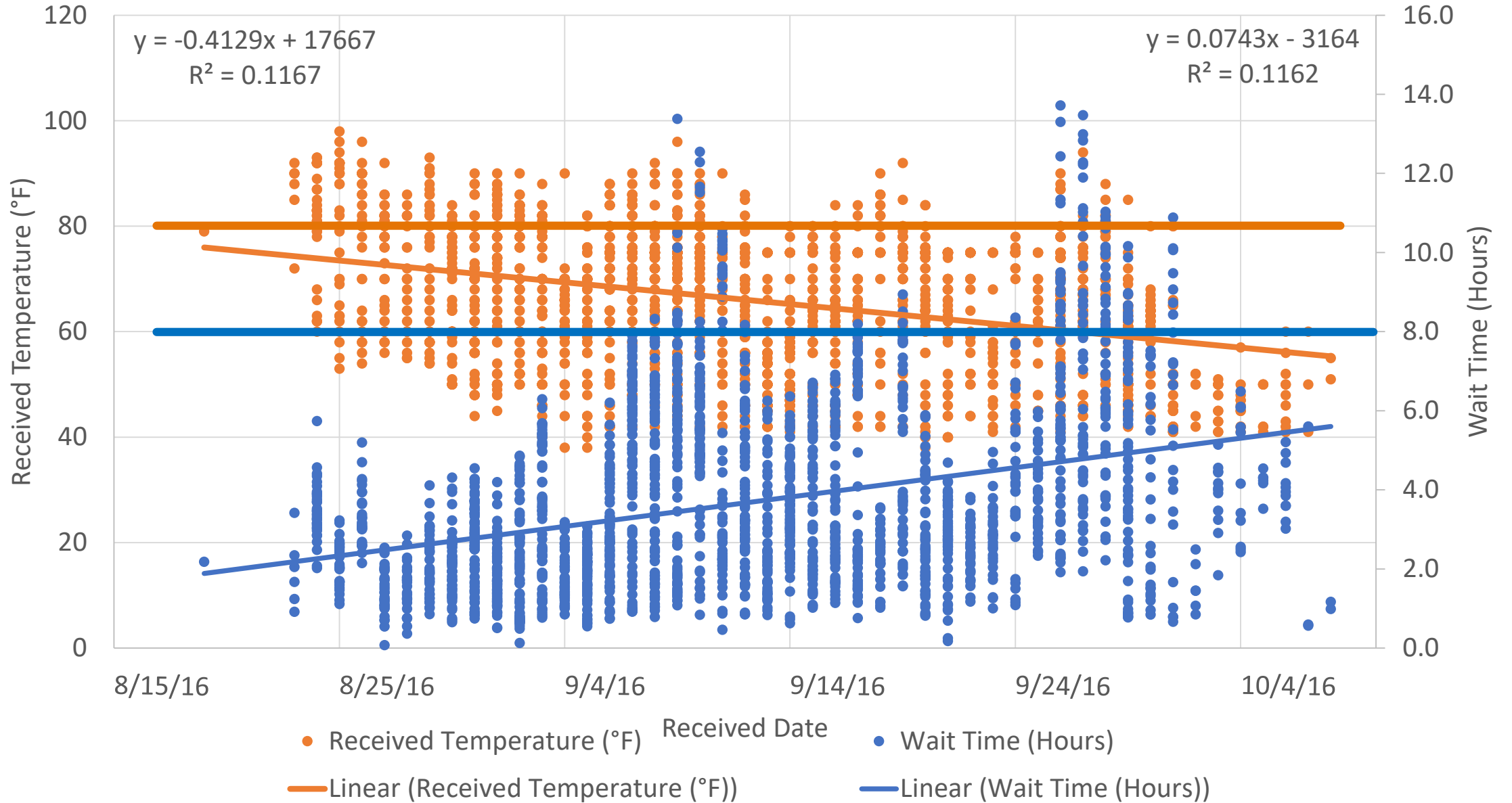


Inhull - Growth of *Salmonella* at 37°C/98°F

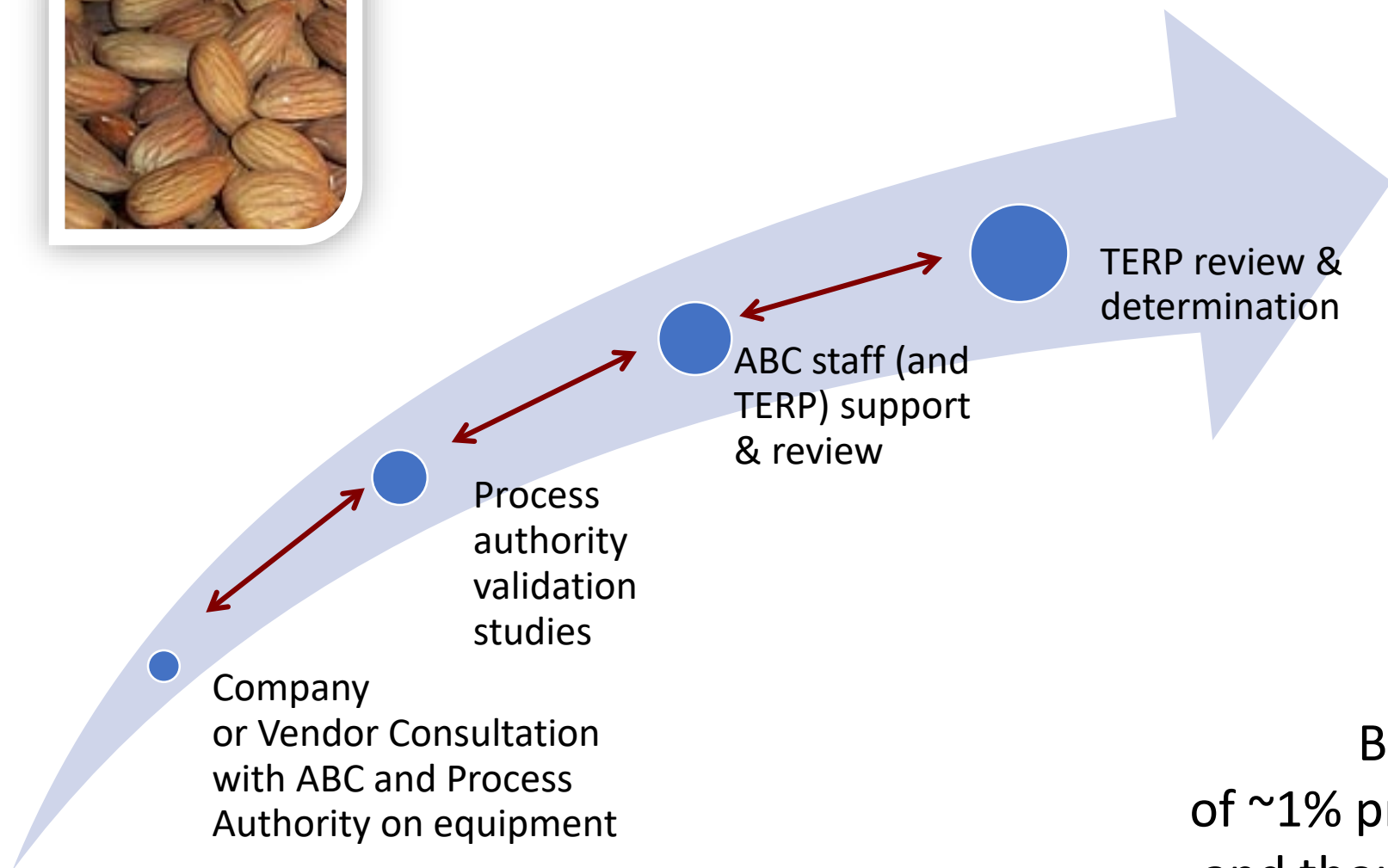


No growth within 3 h at 37°C/98°F
Or 4 to 7 h at 23°C/75°F

Temperature at Receipt and Wait Time



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 and thousands of other data points



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,*}

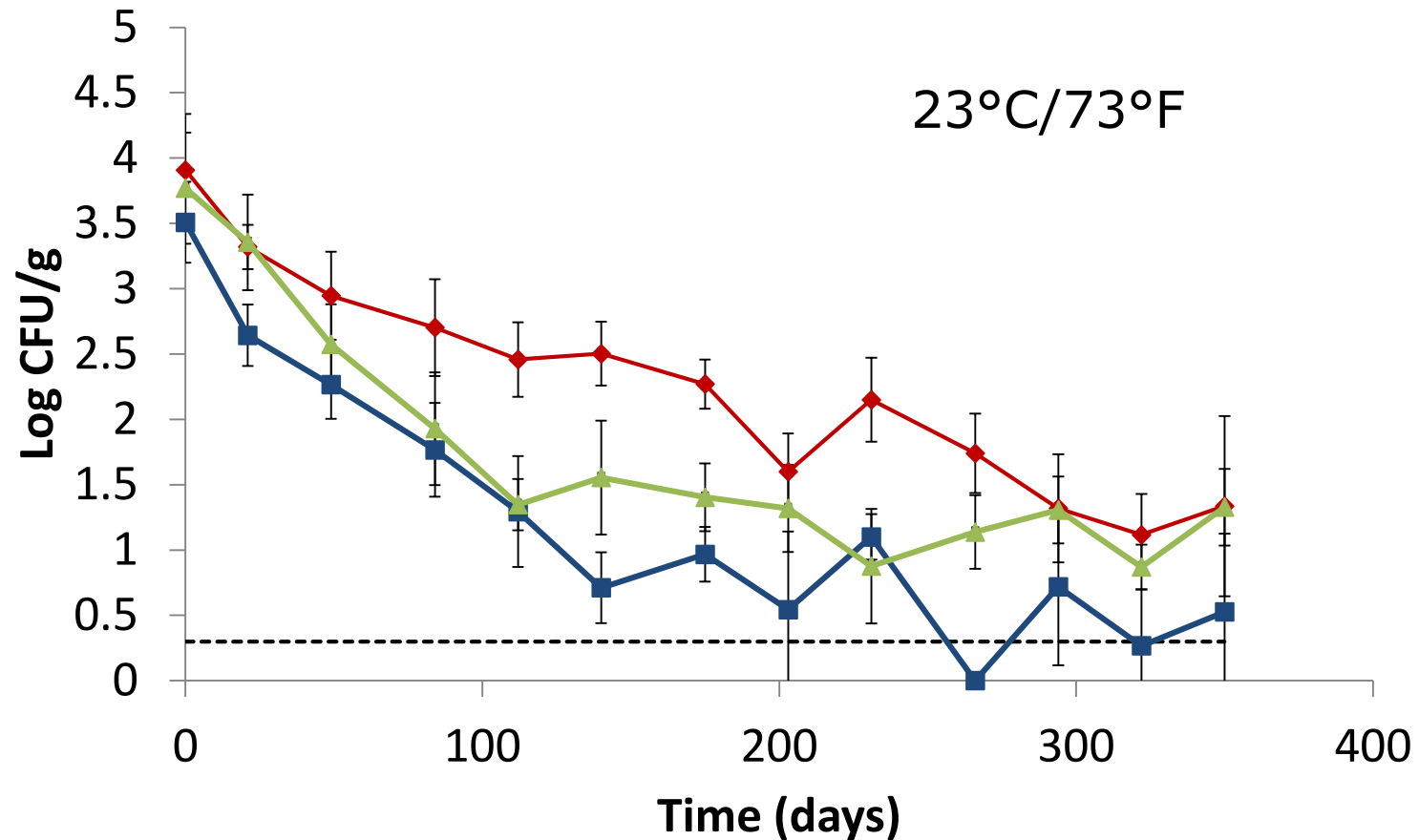
Second Risk Assessment

- 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

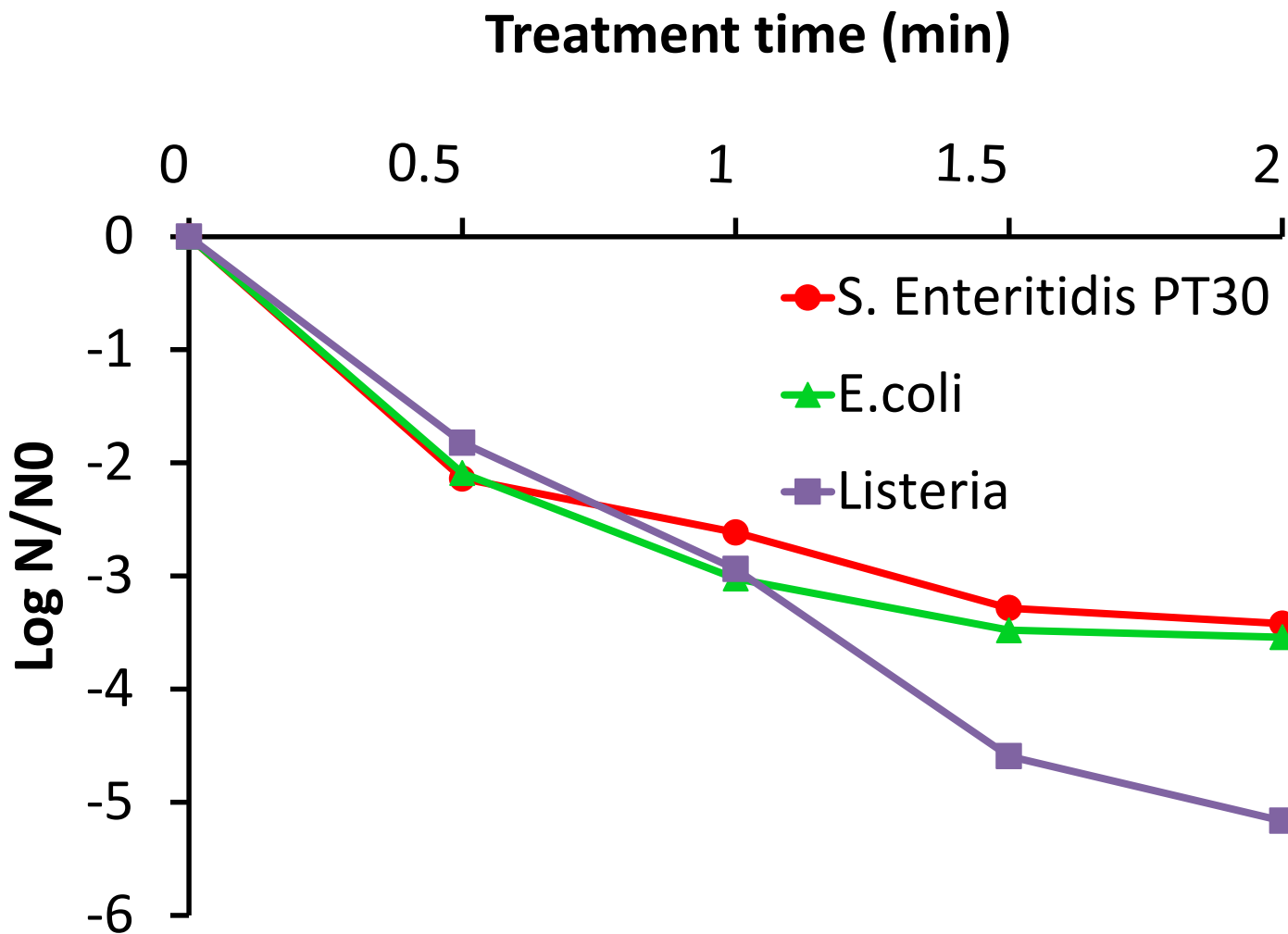


Is *Salmonella* the pathogen of concern in almonds?

Survival of *Salmonella*, *E. coli* O157:H7, and *L. monocytogenes* on stored almonds (ambient temperature)

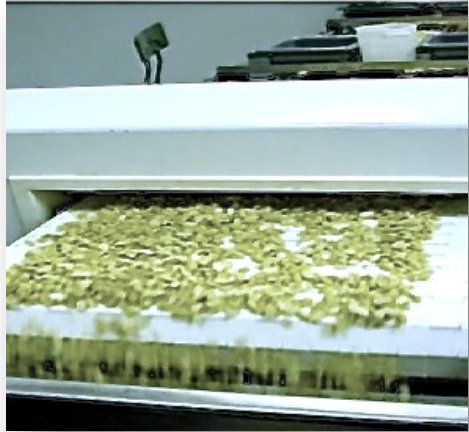


Reduction of *E. coli* O157:H7, *Listeria monocytogenes* and *Salmonella* Enteritidis PT30 on almonds: oil at 250°F



Post Harvest Treatment Options

Wet Heat



Steam
Water
Humidity
Re-wetting
Vacuum

Dry Heat



Convection
Baking,
Roasting,
Infrared, radio
frequency

Nonthermal



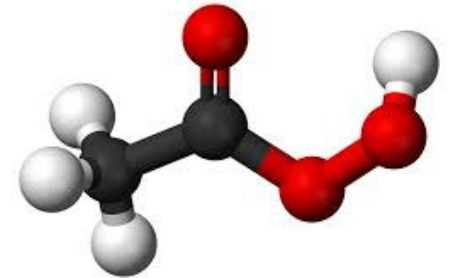
Radiation,
Plasma,
High pressure,
??

Gas



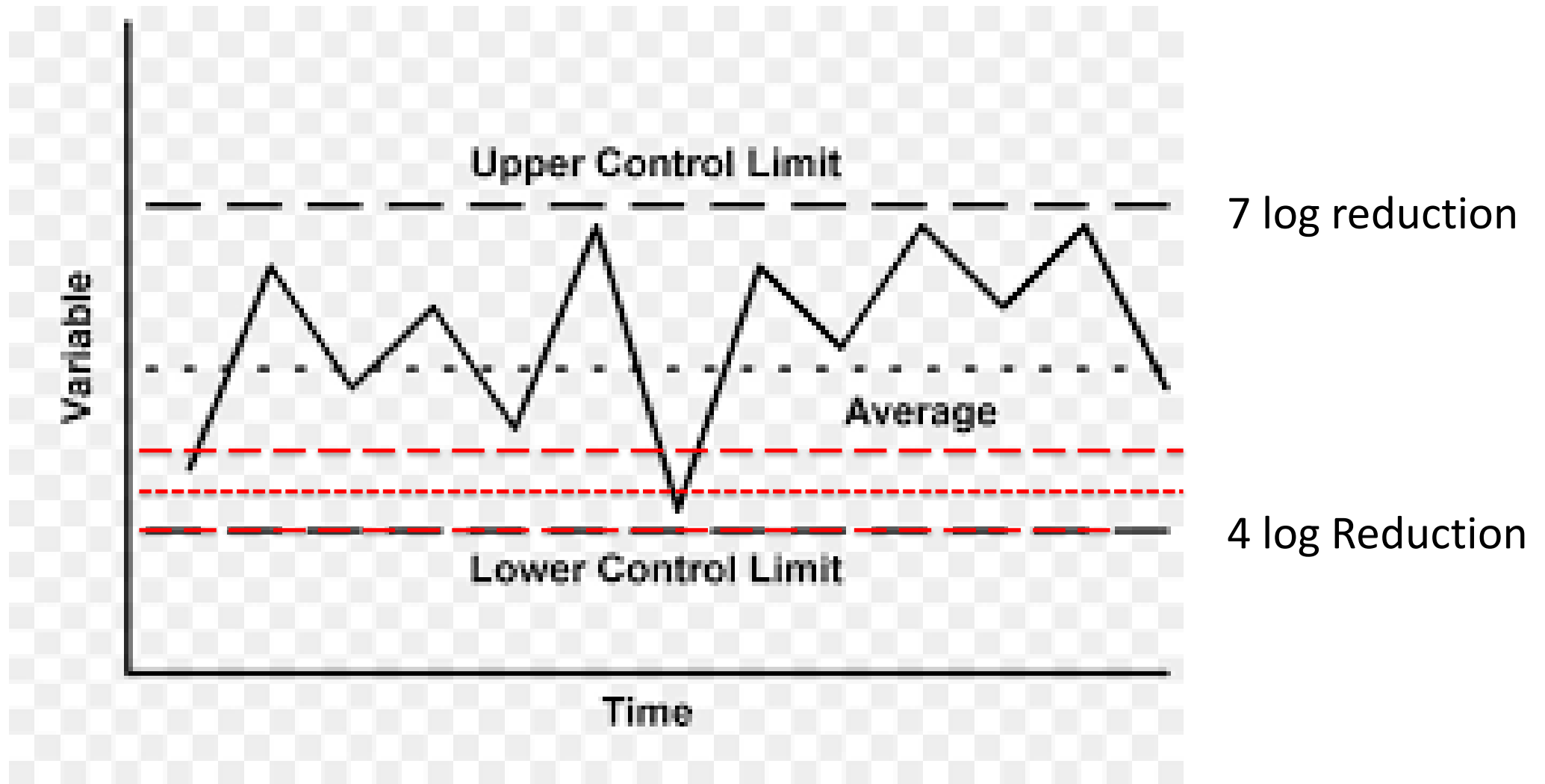
Propylene or
Ethylene
Oxide,
Ozone

Other
Chemical



Peracetic
acid
??

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



PROCESS VALIDATION GUIDELINES

PAST

PRESENT

FUTURE

2006

2019



UPDATE?

CONSUMER TRENDS



“Enhanced Nut”
“Fermented”
“Sprouted”

“RAW ECSTASY”

Soaking, Activating, Sprouting – Big on Blog Sites and the Media



APPETIZERS / SNACKS GLUTEN FREE GRAIN FREE HEALTH & LIFESTYLE RECIPES WLN FAVORITES

HELLO AND WELCOME!

I'm Halle: food lover, modernized hippy, blogger, and a mama trying to feed her



images of d inspire



CalorieBee

DIETITION

WORKOUT ROUTINES

FITNESS EQUIPMENT

CalorieBee » Nutrition

Health Benefits of Soaking Almonds in Water Before Eating

Updated on July 19, 2017



Rajan Singh Jolly » more

Rajan is a botany and chemistry major. He has worked as a poultry breeder for 23 years, breeding layer and broiler parents.

Contact Author

CEREALS ▾

HERBS ▾

BEVERAGE ▾

MINERALS ▾

SEED AND NUT ▾

ESSENTIAL OILS ▾

Home > Seeds and Nuts > Almond

13 Surprising Benefits Of Almonds Nutrition



Is Soaking Nut & Learn How

Should

BY AQIYL ANIYS | APR

Benefits Of

Why Soaked Almonds are Better Than Raw Almonds

Gargi Sharma, Weight Management Expert | Updated: November 24, 2017 12:12 IST



Highlights

- Almonds are rich in nutrients like Vitamin E and Omega 3
- Some believe that almonds have been around for almost 19,000 years
- Almonds curb your appetite and keep you full for longer

Rich, crunchy and gorgeous - Brown cased **almonds** (*badaam*) are not just rich in vitamins and nutrients, they're also a real joy to cook with. Shred them over some **creamy kheer**, toast them to make a soft and **air-light souffle** or grind them to make some luscious **Badaami Korma** - they're one of the most commonly found and loved nuts.

31 Benefits of Overnic

ed Almonds

Search...

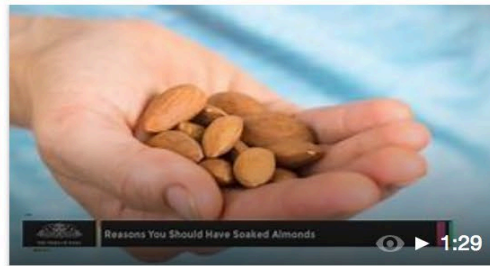


31 Benefits of Overnic

Hundreds of How-To Videos



How to soak almonds
3 years ago
[youtube.com](https://www.youtube.com)



Reasons You Should Have Soaked Almonds
2 years ago
[youtube.com](https://www.youtube.com)



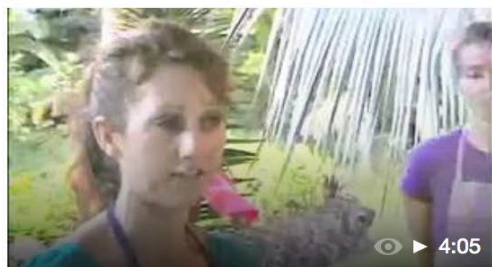
Almonds - Soaking, fermenting, flour and butter
4 years ago
[youtube.com](https://www.youtube.com)



Are soaked almonds better to eat?
3 years ago
[youtube.com](https://www.youtube.com)



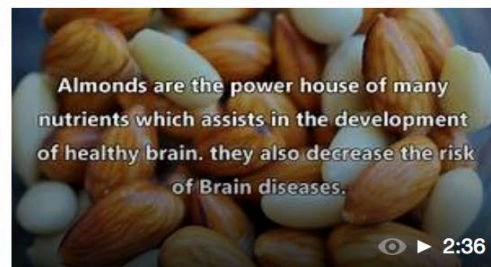
Soaking Almonds, Nuts and Seeds To Improve Nutrient Uptake and
5 years ago
[youtube.com](https://www.youtube.com)



Enzymes, Almonds & Soaking
10 years ago
[youtube.com](https://www.youtube.com)



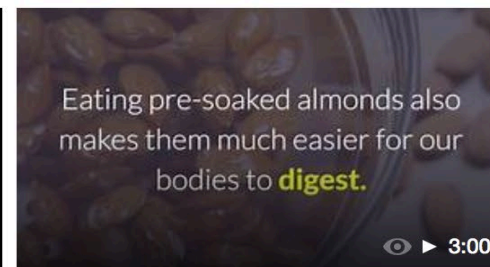
HOW TO SOAK ALMONDS pt. 1 of 3
2 years ago
[youtube.com](https://www.youtube.com)



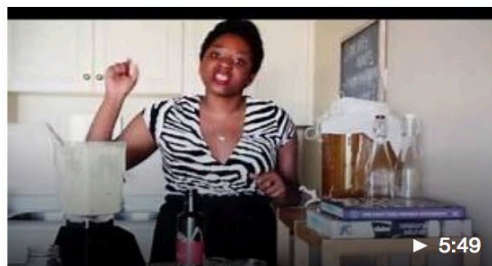
Soak 12 ALMONDS IN WATER OVERNIGHT AND EAT IT NEXT
2 months ago
[youtube.com](https://www.youtube.com)



Benefits of Soaking Almonds in Water
1 year ago
[youtube.com](https://www.youtube.com)



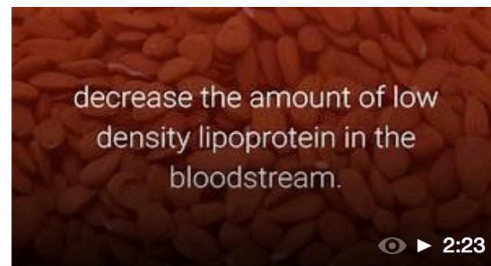
6 Reasons to Soak Almonds Before Eating Them
5 months ago
[youtube.com](https://www.youtube.com)



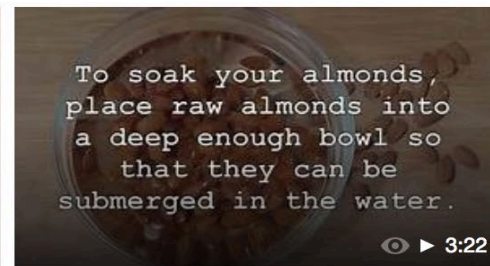
The Benefits of Soaking Almonds and Vegan Almond Mayo!
4 years ago
[youtube.com](https://www.youtube.com)



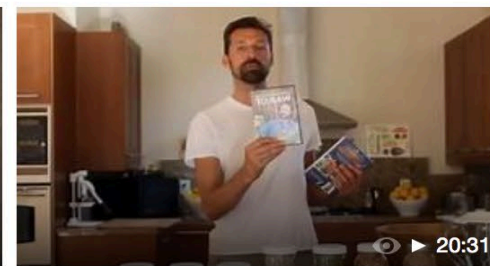
Burn Fat and Balance Your Blood Sugar with Soaked Almonds for
5 years ago
[youtube.com](https://www.youtube.com)



SOAK 4 ALMONDS IN WATER OVERNIGHT AND EAT IT NEXT
7 months ago
[youtube.com](https://www.youtube.com)

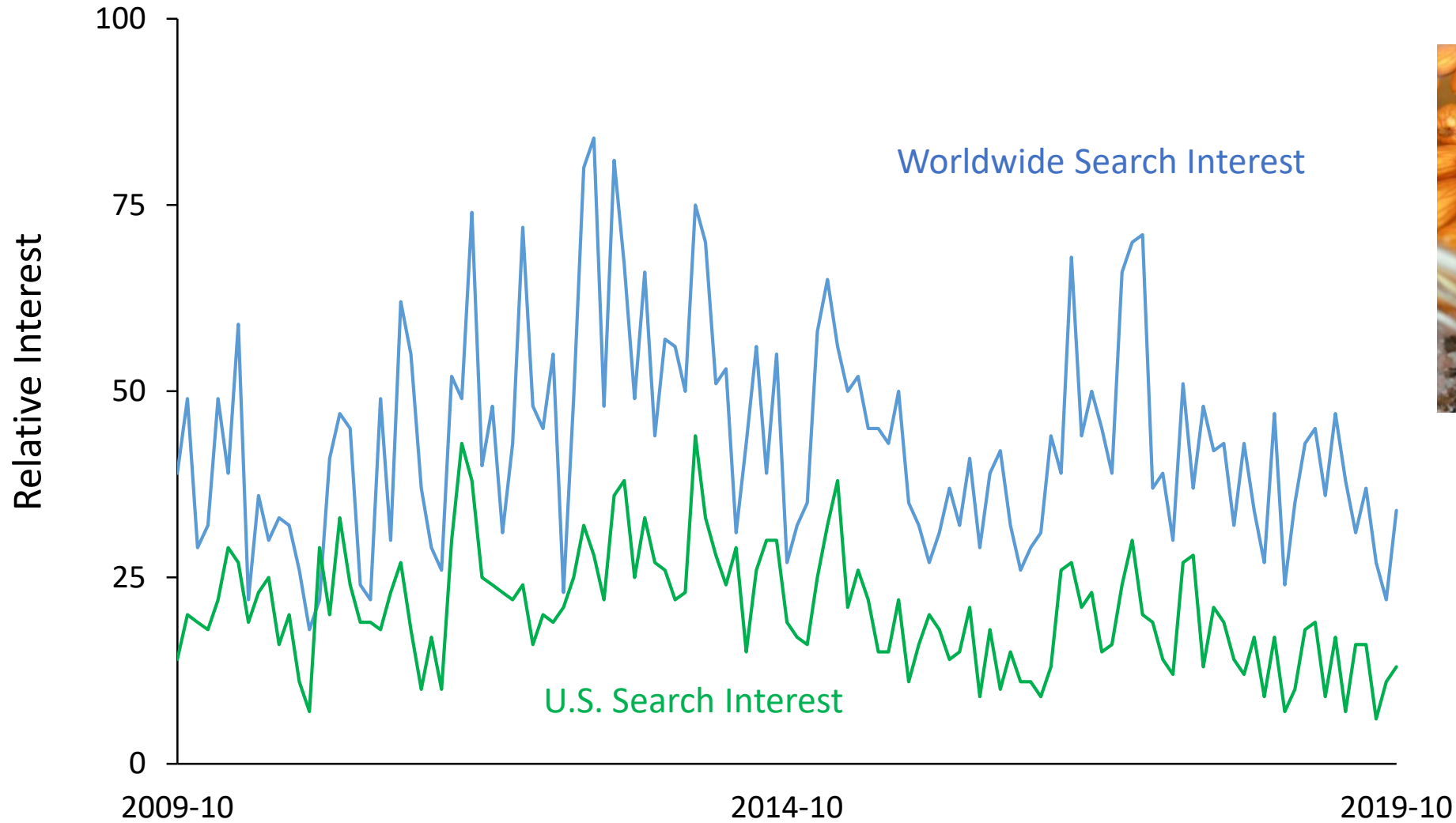


Why You Should Always Soak Almonds Before Eating Them
7 months ago
[youtube.com](https://www.youtube.com)



HOW TO SOAK NUTS AND SEEDS ~ VIDEO TUTORIAL
3 years ago
[youtube.com](https://www.youtube.com)

Google Trends Search Interest “Soaking Almonds”

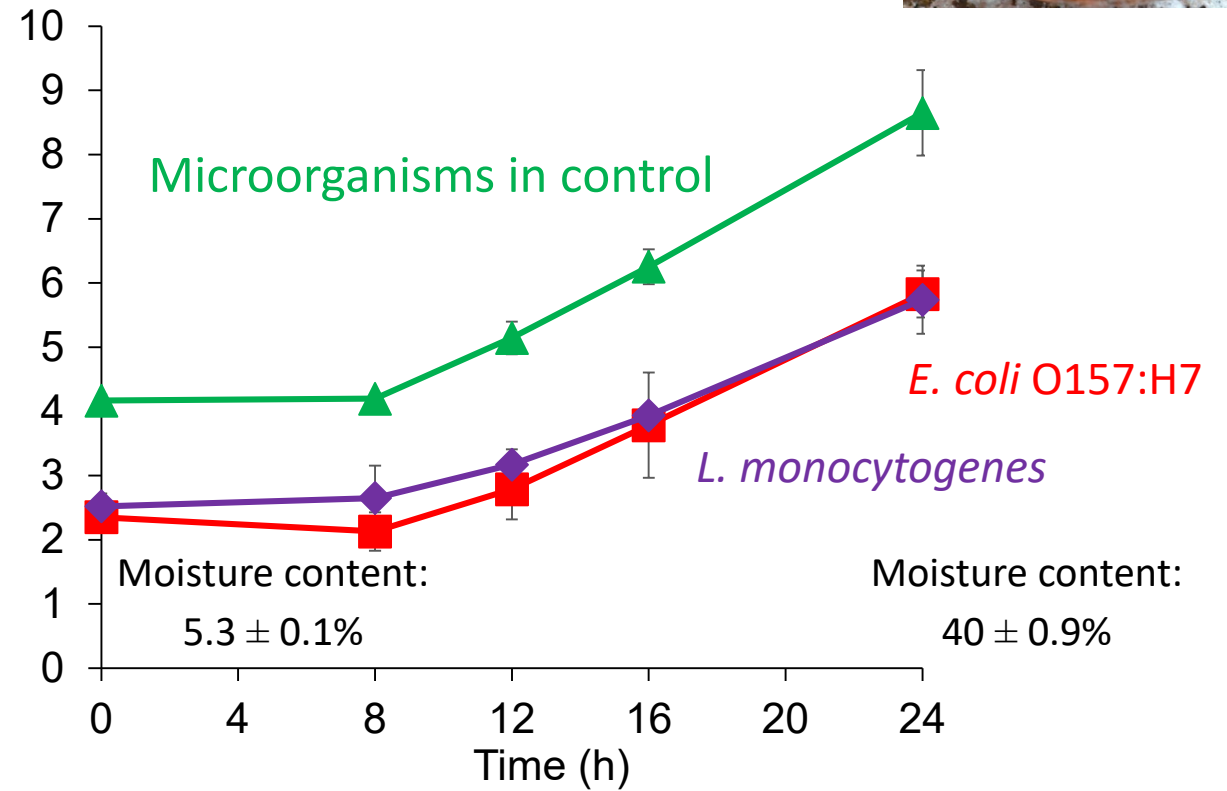
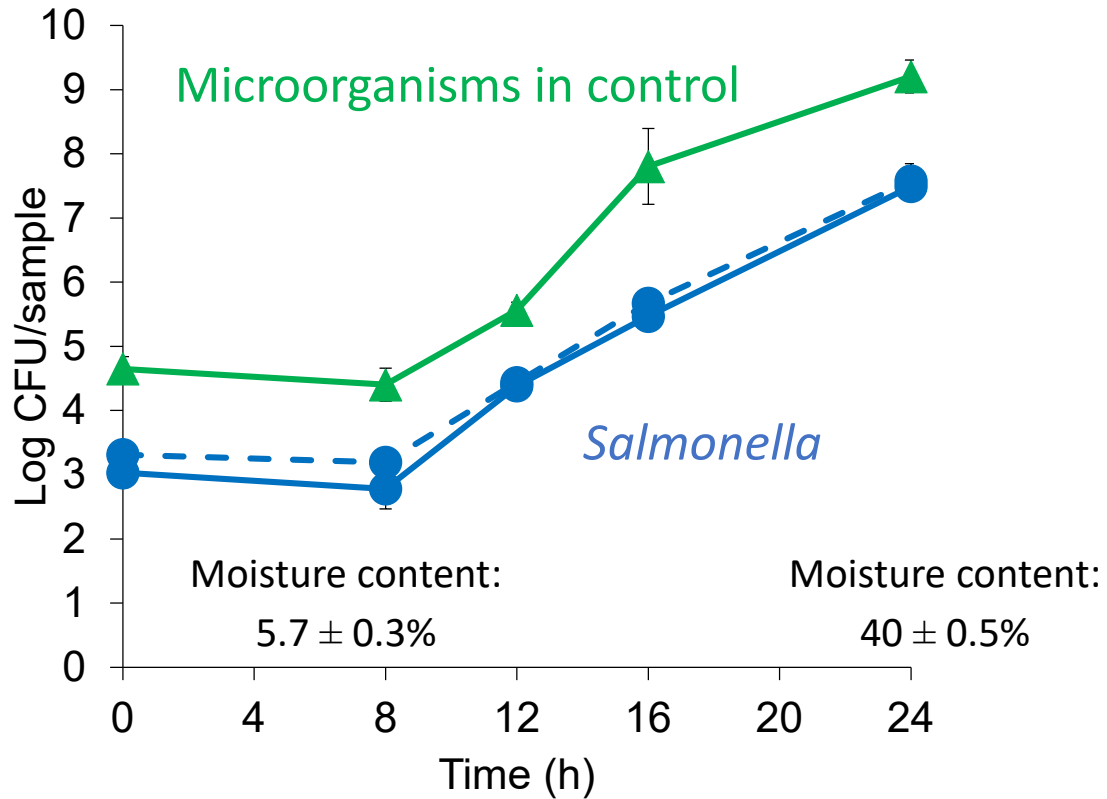


Data were retrieved from <https://trends.google.com/> on November 6, 2019.

Commercial Products Increasingly Available



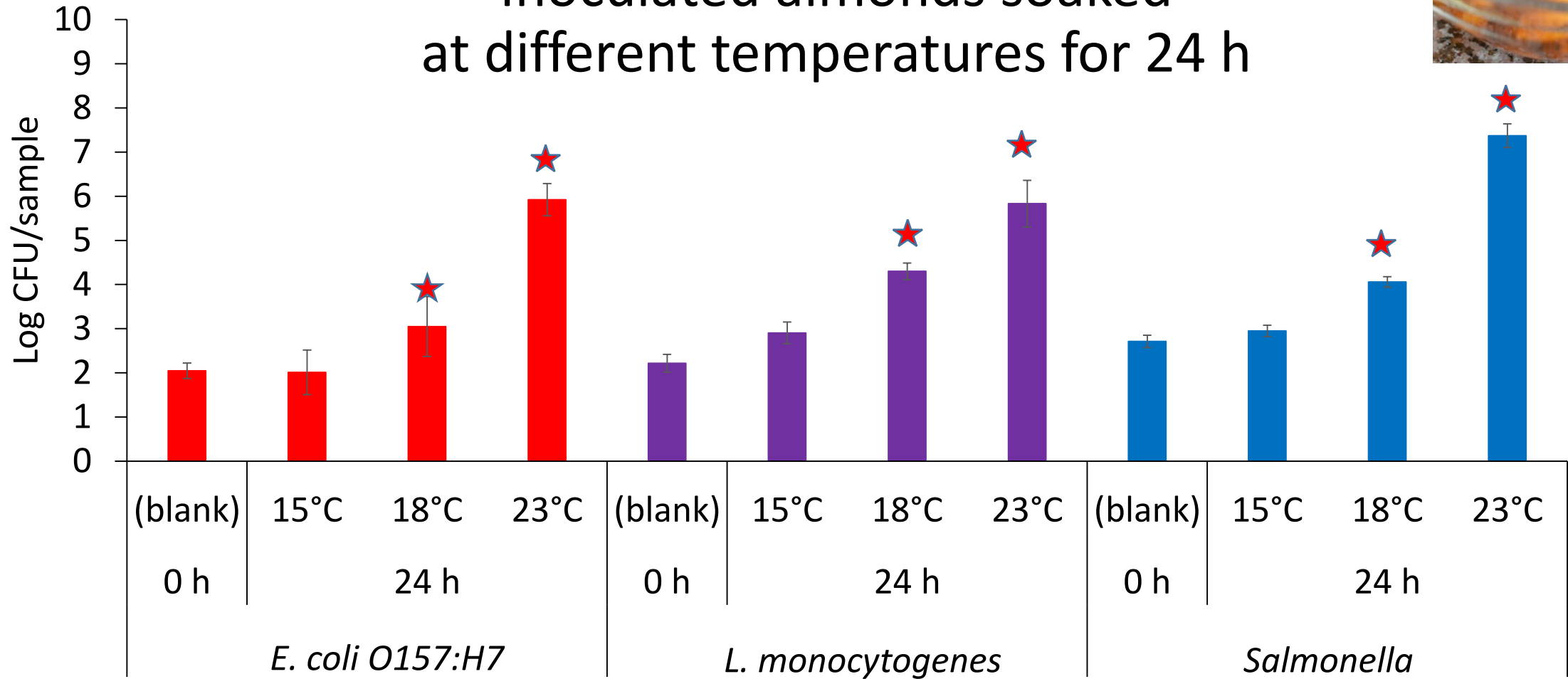
Can pathogens grow in soaked almonds?



Will pathogens grow at lower temperatures?



Inoculated almonds soaked at different temperatures for 24 h

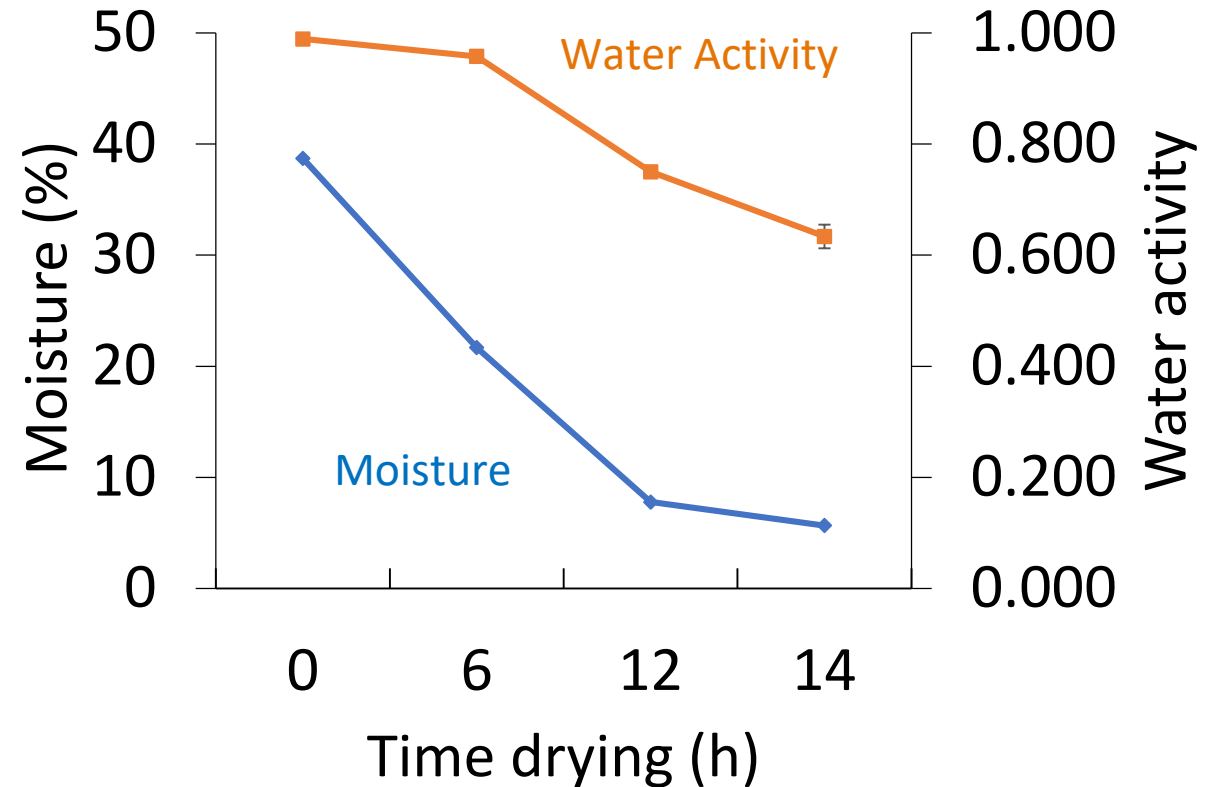
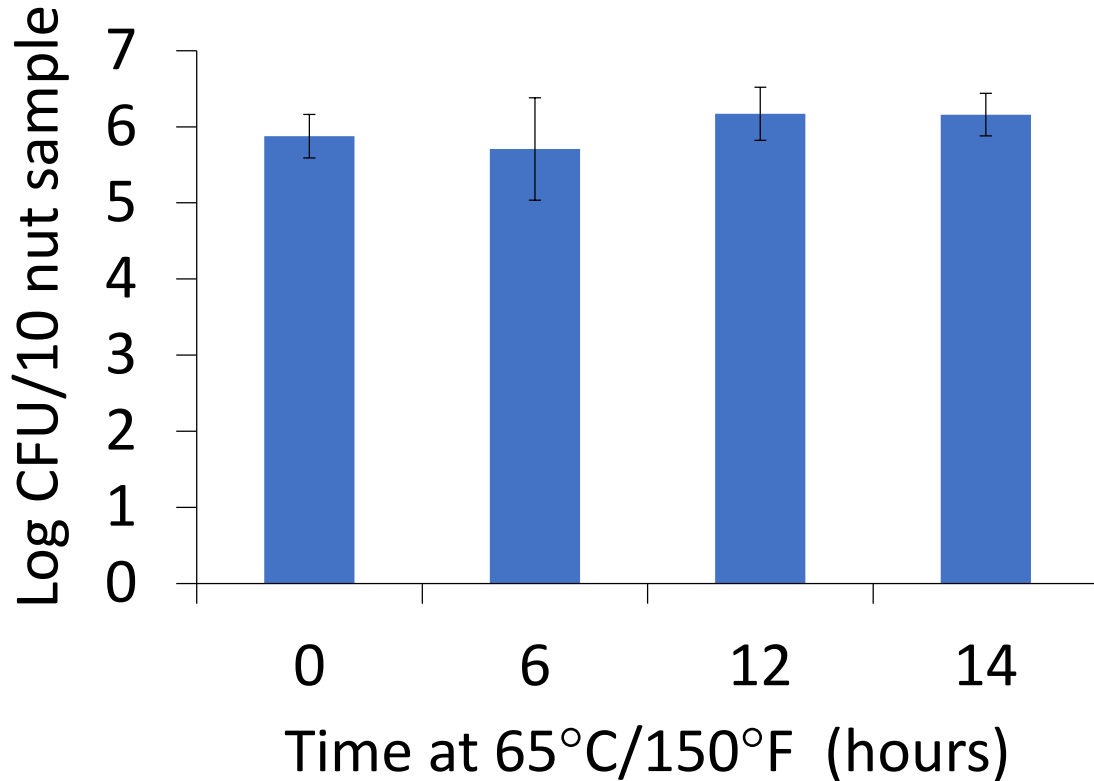


Storage time and temperature

Does *Salmonella* die when drying soaked almonds?



Salmonella on inoculated almonds soaked in sterile ultrapure water for 24 h then dried





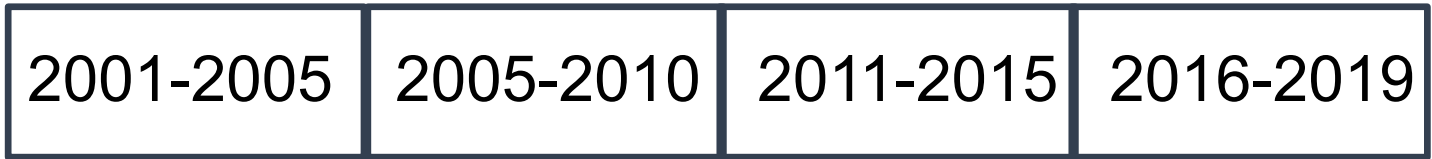
EVERYONE PLAYS A ROLE IN FOOD SAFETY

Grower

Huller/
Sheller

Handler

Customer/
Consumer



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



Remaining vigilant

Continually assessing trends
across the supply chain
and potential food safety risks



the Almond
CONFERENCE
2019

Almond Food Safety: Past, Present and Future

 **california
almonds**[®]
Almond Board of California

Upcoming Sessions at 2:15 p.m.

- Sterile Insect Control of Navel Orangeworm (Room 1)
- India: Strong Today, Stronger Tomorrow (Room 2)
- Could Cover Crops or Whole Orchard Recycling Help with Orchard Management? (Room 3)



Visit the Exhibit Halls and Participate in the Passport Game

• 3P Partners	#2206	• K•Coe Isom	#707
• ABC Booth	#526	• Lincoln Agribusiness Services	#733
• AC Horn	#421	• Napasol	#2205
• Ag Spray Equipment	#2203	• NETZSCH Premier Technologies	#218
• Bayer CropScience	#127	• Satake	#521
• Best Drayage	#2112	• Suterra, LLC	#1638
• Bird Gard, LLC	#1812	• TOMRA Sorting Solutions	#335
• Borrell USA	#327	• Trécé, Inc	#516
• Cablevey Conveyors	#217	• Valent U.S.A.	#621
• Central Life Sciences	#917	• Westbridge Agricultural Products	#1534
• JAX, Inc.	#413	• Wilkey Industries	#320
• JKB Energy	#635	• Yara North America	#627

The first 500 attendees to turn in a completed passport card to the ABC booth (#526) will receive a hat and will be entered to win one of seven amazing prizes!



Lunch: Pushing Your Personal Limits

Featuring John Stenderup



Sponsored by:



Doors open at 12:15 p.m. in Building C
You must have already purchased a ticket to attend luncheon

Food Truck Village

Food Truck Village is located next to Building D

Open on Tuesday and Wednesday from 11:00 a.m. – 2:30 p.m.

Cash and credit cards are accepted





Shuttle Schedule

Shuttle service will be provided by The Almond Conference from the downtown hotels to Cal Expo daily.

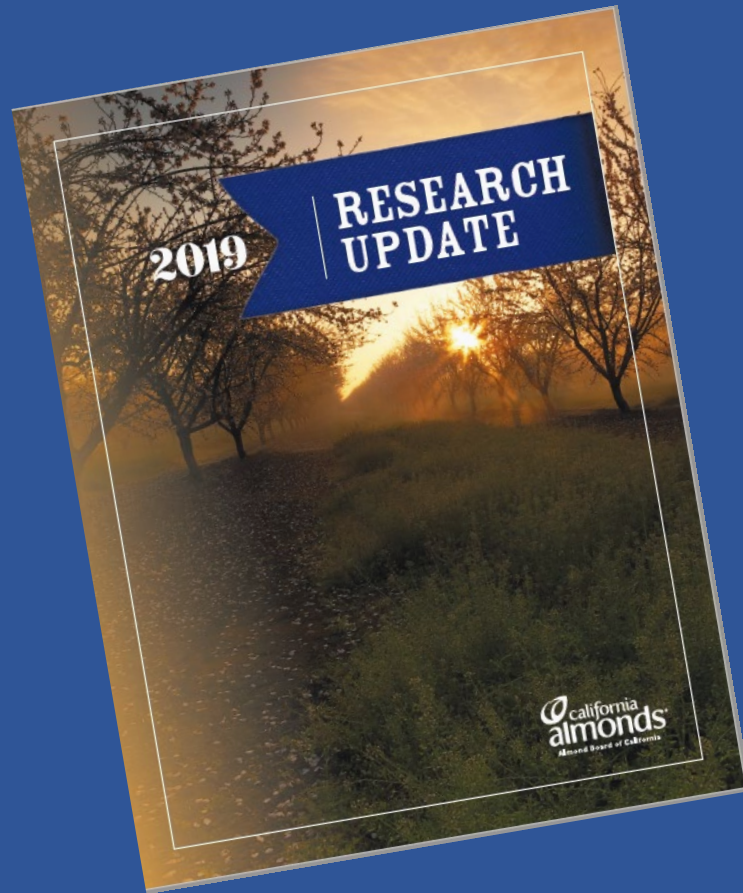
- Downtown Pickup Location: Hyatt Sacramento Front Drive
- Cal Expo Pickup and Drop-Off Location: Blue Gate

Shuttle Schedule:

- Tuesday, Dec. 10
 - 6:45 a.m. – 6:30 p.m.
- Wednesday, Dec. 11
 - 6:45 a.m. – 6:30 p.m.
- Thursday, Dec. 12
 - 6:45 a.m. – 1:30 p.m.

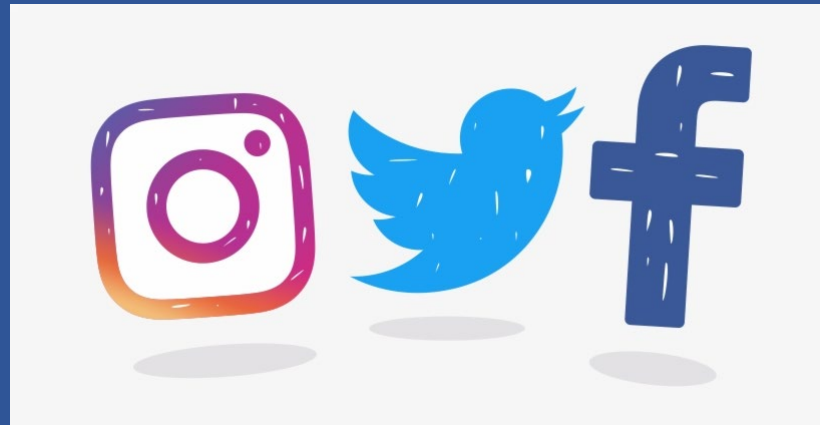


2019 Research Update



Pick up a
copy at the
ABC booth
#526

Join the Conversation!



Use **#AlmondConf** to share highlights
from The Almond Conference

Dedicated Trade Show Time

4:30 p.m. – 6:00 p.m.

Social Reception Sponsored by:



Join Tonight's Social Reception

Come and Sample: ALMOND BROWN ALE

Stop by:

The Almond Board Lounge in Building D.

Sample:

Almond brown ale during the Tuesday and Wednesday receptions.

This almond beverage is the result of a special project from Dominique Camou and Lucas Schmidt in collaboration with **Tembler Brewing Company**.

Industry members and attendees are welcome to stop by and have a taste.

When:

Tuesday and Wednesday evening reception from 4:30–6:00 p.m.



4:30 p.m. – 6:00 p.m. - Pavilion + Building D



10 YEARS OF PROGRESS

JOIN THE JOURNEY

It's all there at

SustainableAlmondGrowing.org



Thank you!