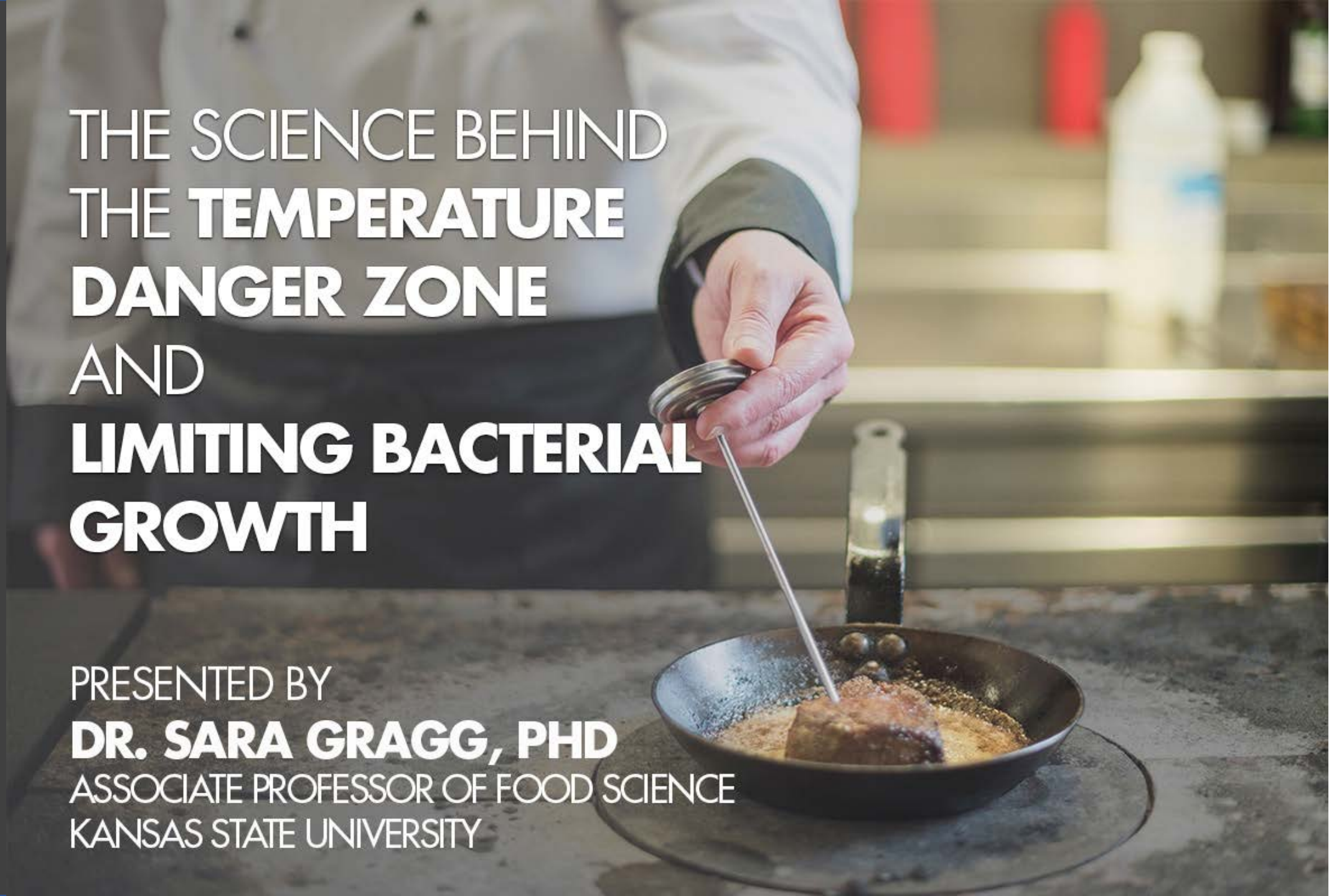
SafeBites®
from FoodHandler

THE SCIENCE BEHIND THE **TEMPERATURE DANGER ZONE** AND **LIMITING BACTERIAL GROWTH**



PRESENTED BY

DR. SARA GRAGG, PHD

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Our Food Safety Expert

Dr. Kevin Roberts, PhD

Meet our Presenter:

Dr. Sara E. Gragg, PhD

Associate Professor of Food Science,
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OBJECTIVES

FoodHandler®

- Explain the temperature danger zone and the importance of temperature control in food handling.
- Discuss the food safety risk associated with improper holding temperature.
- Discuss research results related to the safety of food served away from the school or to-go.
- Describe the bacterial risks associated with improper cooling and discuss research related to the safety of common foodservice cooling methods.

FOODBORNE ILLNESS IN THE UNITED STATES

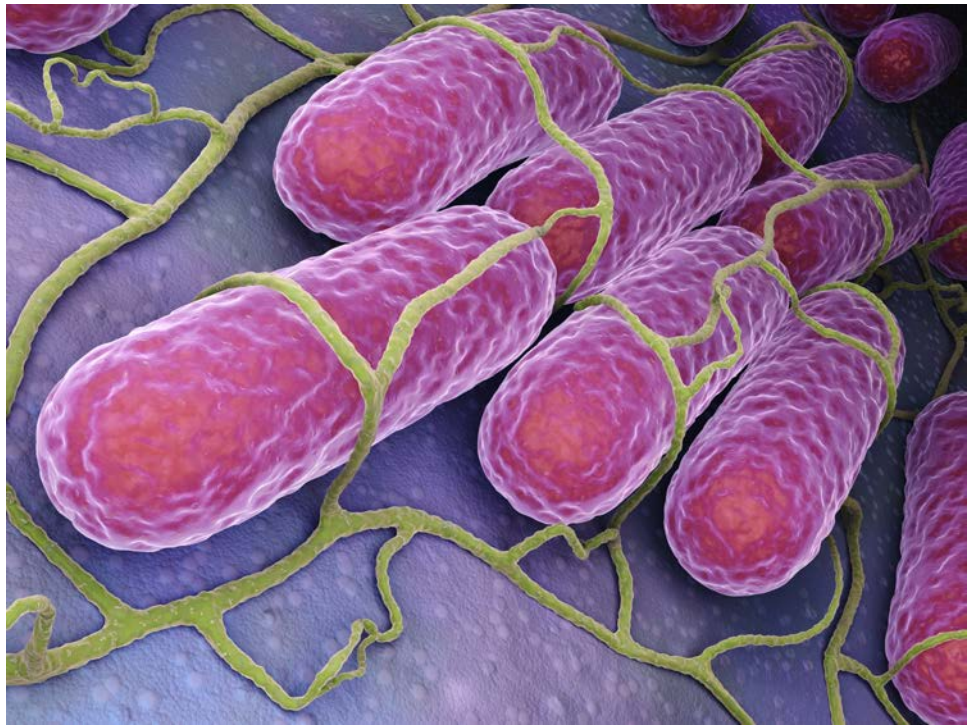
FoodHandler®

- Annual estimates:
  - 48 million illnesses
  - 128,000 hospitalizations
  - 3,000 deaths

(Scallan et al., 2011a,b)

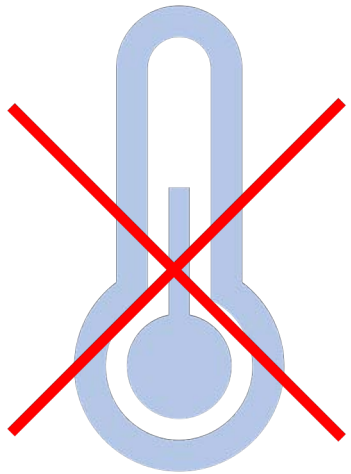
- Approximately 1,000 disease outbreaks

(FDA Food Code, 2017)



CAUSE OF FOODBORNE ILLNESS

- Improper holding temperatures
- Inadequate cooking
- Contaminated equipment
- Food from unsafe sources
- Poor personal hygiene



(FDA Food Code, 2017)

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Objective 1:

Explain the temperature danger zone and the importance of temperature control in food handling

PROPER HOLDING TEMPERATURES

FoodHandler®

KEEP HOT FOODS HOT AND COLD FOODS COLD

- Temperature Danger Zone
  - 40°F to 140°F*
- Prevent or slow bacterial growth by holding food:
  - Below 40°F (cold foods)

    OR
  - Above 140°F (hot foods)
- Protect foods from cross-contamination

(Matthews, et al., 2017)

*FDA Food Code (2017): 41°F to 135°F

PROPER HOLDING TEMPERATURE
EXAMPLES OF PATHOGENS FOR CONTROL

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Hot Holding

- *Bacillus cereus*
- *Clostridium botulinum*
- *Clostridium perfringens*
- *Staphylococcus aureus*

Cold Holding

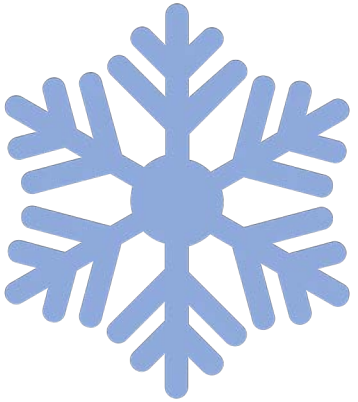
- *Bacillus cereus*
- *Clostridium botulinum*
- *Clostridium perfringens*
- *Listeria monocytogenes*
- *Staphylococcus aureus*
- *Vibrio* spp.

Other pathogens (*e.g. Salmonella*) may grow if the food becomes cross-contaminated!

(FDA Food Code, 2017)

PROPER COOLING

- Cool foods rapidly
- Minimize time food spends in temperature danger zone
- FDA Food Code (2017):
  - Within 2 hours of cooking: cool to 21.1 °C (70°F)
  - Within 6 hours of cooking: cool to 5°C (41°F)



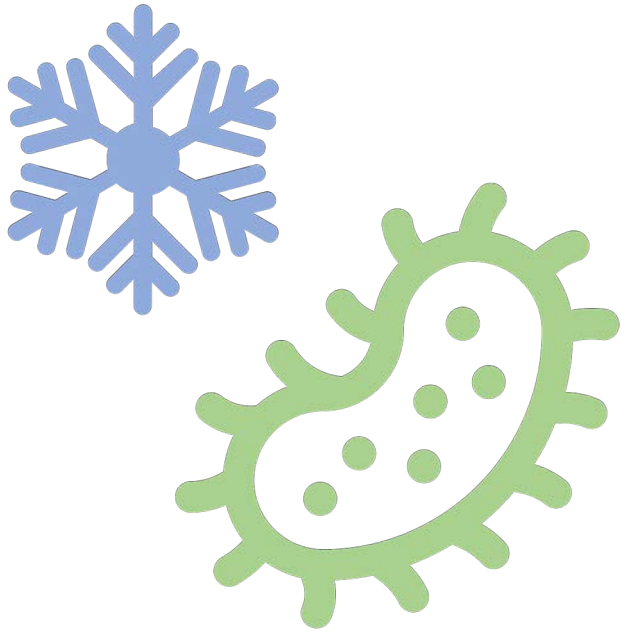
- Must consider the following:
  - Volume/quantity of food, container cover, chilling method or equipment, food type/density, etc.

(FDA Food Code, 2017)

PROPER COOLING
EXAMPLES OF PATHOGENS FOR CONTROL

FoodHandler®

- *Bacillus cereus*
- *Clostridium botulinum*
- *Clostridium perfringens*
- *Staphylococcus aureus*



Other pathogens (*e.g. Salmonella*) may grow if the food becomes cross-contaminated!

(FDA Food Code, 2017)

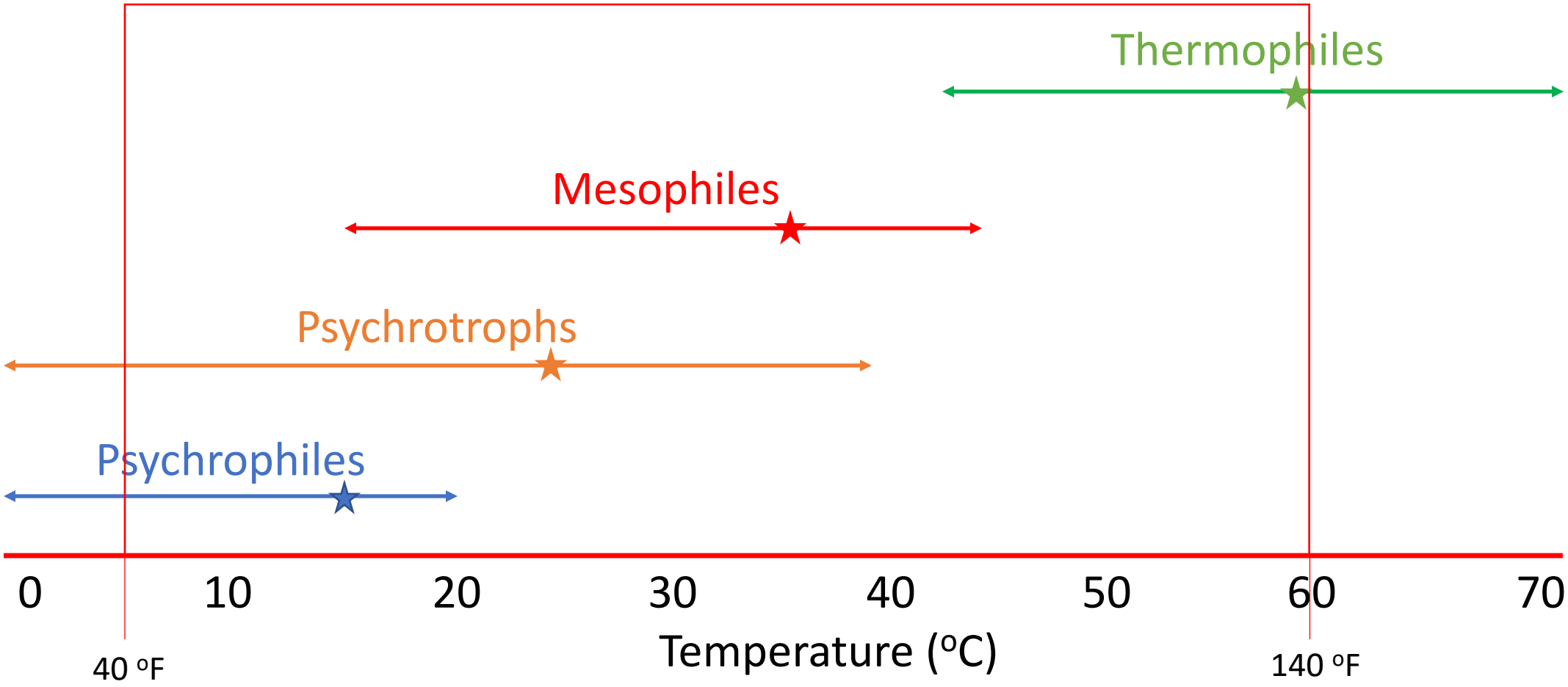
SafeBites® from FoodHandler

Objective 2:

Discuss the food safety risk associated with improper holding temperature

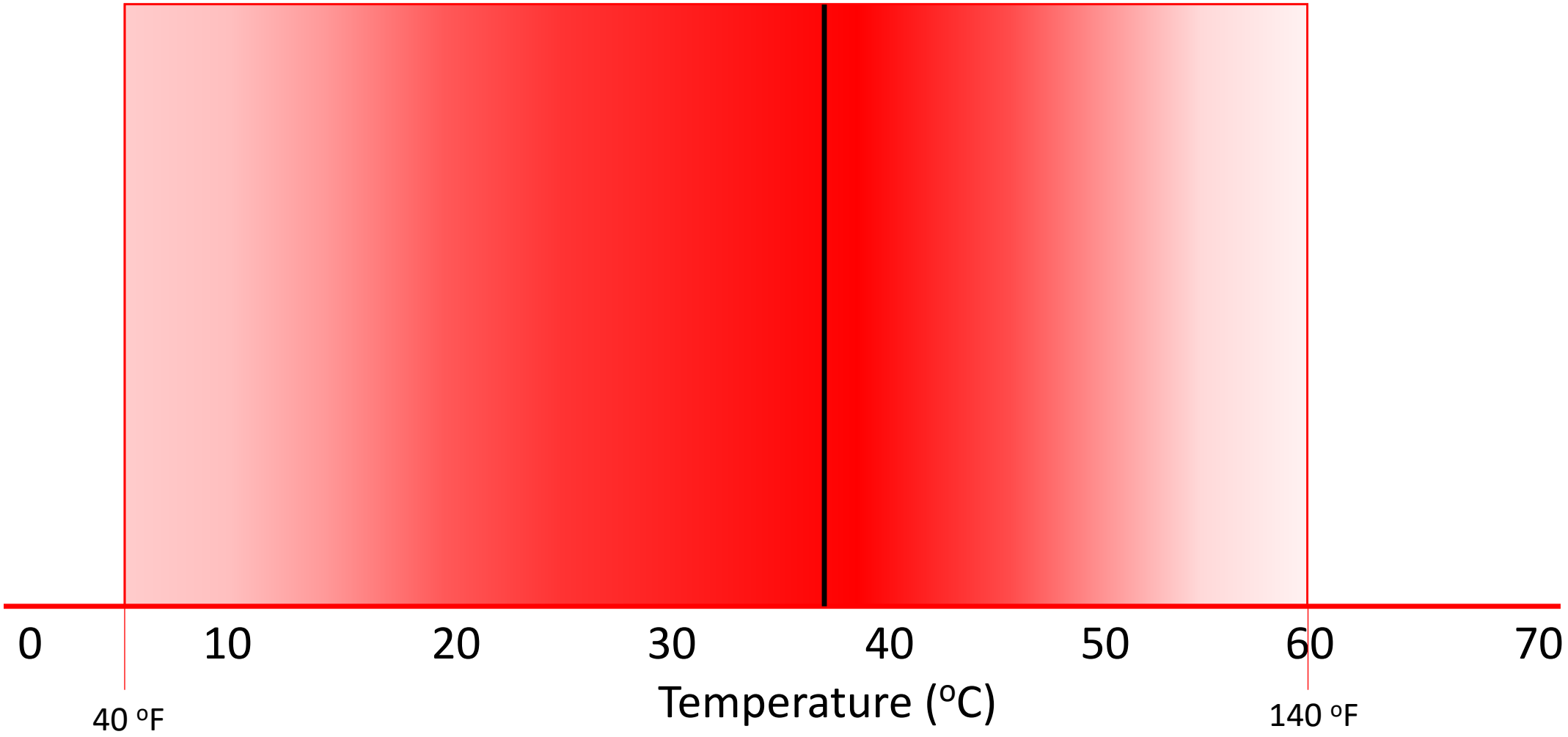
TEMPERATURE AND BACTERIAL GROWTH

FoodHandler®



TEMPERATURE AND BACTERIAL GROWTH

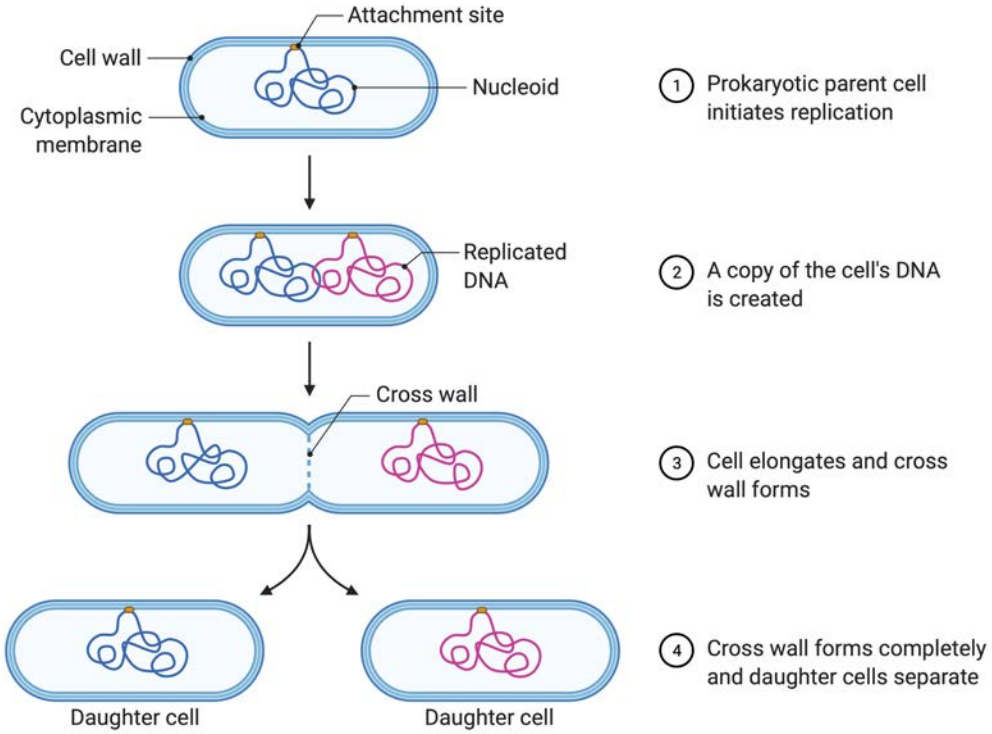
FoodHandler®



BACTERIAL MULTIPLICATION

FoodHandler®

- Binary fission
  - Asexual reproduction
  - One cell divides into two cells
  - Two cells divide into four cells
  - And so on…
- Generation time
  - Time it takes for bacteria to divide
  - Optimum conditions: ~20-60 mins



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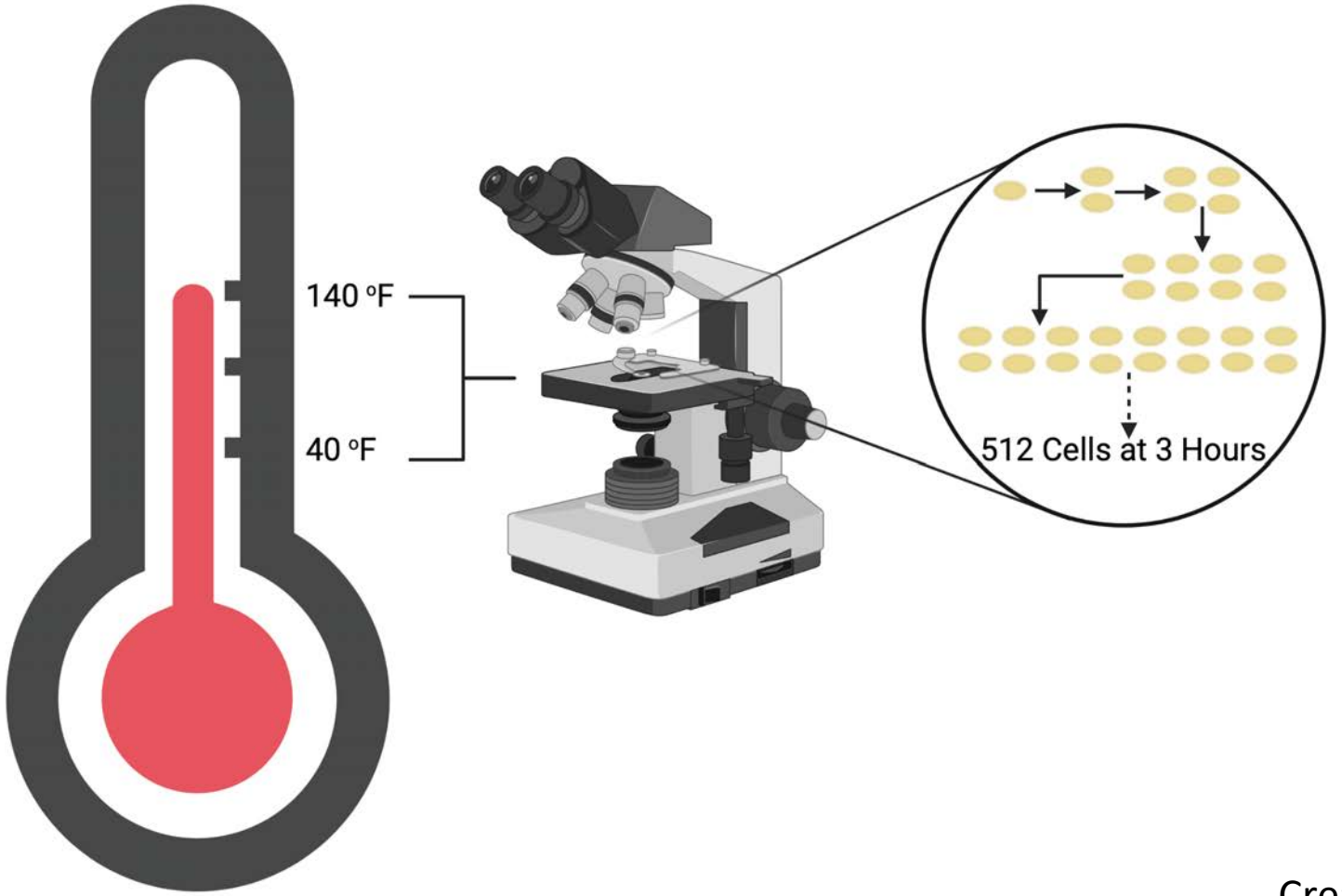
BACTERIAL MULTIPLICATION
20 MINUTE GENERATION TIME

FoodHandler®



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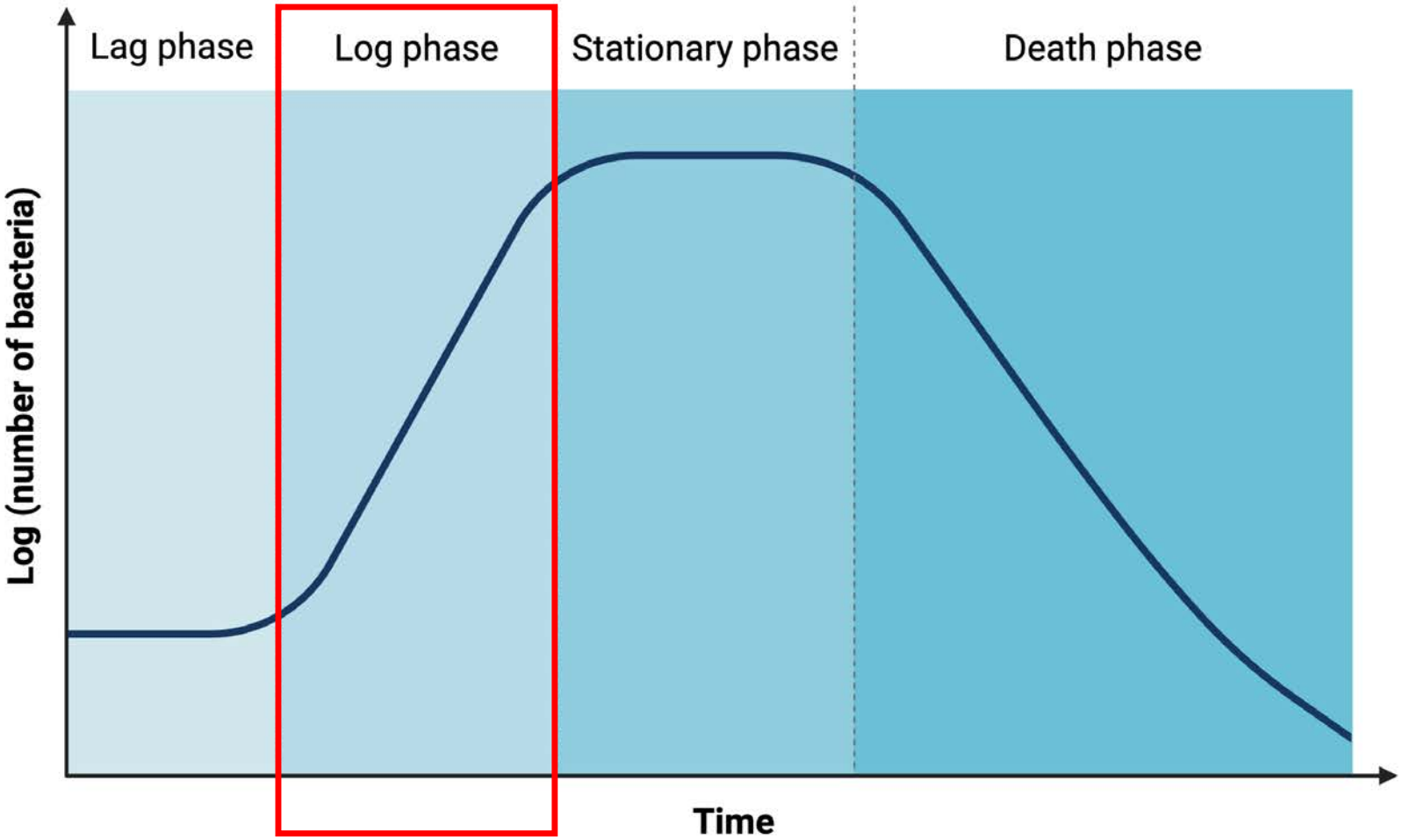
Bacterial Growth Curve



Avoid the log phase!

BACTERIAL GROWTH CURVE

FoodHandler®

- Conditions can be altered to:
  1. Prevent introduction of microbes into food
     - Or reduce the level of microbes introduced
  2. Kill microbes already present
  3. Extend the lag phase
  4. Reduce logarithmic growth phase

Proper Temperature Control!

Temperature isn't the only thing that impacts bacterial growth…

OTHER FACTORS THAT IMPACT BACTERIAL GROWTH

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- pH
- Water activity
- Nutrient source
- Oxygen
- Presence of other bacteria

Objective 3:

Discuss research results related to the safety of food served away from the school or to-go

PEER-REVIEWED ARTICLE

Food Protection Trends, Vol 39, No. 1, p. 8–17

6200 Aurora Ave., Suite 200W, Des Moines, IA 50322-2864

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Simulation of Time and Temperature as a Public Health Control for Food Served during Field Trips

STUDY OBJECTIVES

FoodHandler®

- Determine the growth of foodborne pathogens in school lunch meals served off-site, packaged in insulated coolers, and exposed to extreme environmental conditions.

- Quantify population changes of *Listeria monocytogenes* and *Salmonella* on carrots, turkey sandwiches, and apple slices placed in coolers and held under conditions that simulate storage on a school bus.

(Gragg et al., 2019)

FOOD PRODUCTS

- Frequently consumed on field trips
  - Turkey sandwiches
  - Sliced apples
  - Baby carrots

(Sneed and Patten, 2015)

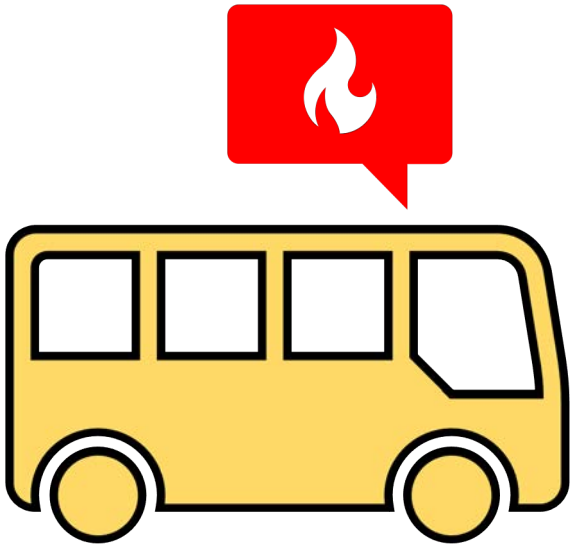
- Prepared in accordance with National School Lunch Program meal requirements

(USDA, 2012)

SIMULATING A HOT SCHOOL BUS

FoodHandler®

- Phase one: Temperature data loggers on school buses
  - Two locations during warm weather
    - North Carolina (May 12-21 and June 2-4)
    - Arkansas (May 27)
  - Four data loggers per bus
    - Two internal and two external
  - Data between 8 am and 1 pm of most interest
    - Assumed an 8 am departure and 1 pm lunch
  - Used data to program an electronically controlled thermal processing unit (ECTPU)
    - Simulate high-risk temperature changes on a school bus



(Gragg et al., 2019)

TABLE 1. Commercial ECTPU program used to subject sack lunches stored in coolers to temperature abuse conditions that simulate a high-risk school field trip scenario

Step	Program	Relative Humidity (%)	House Temperature (°C/°F)	Time (minutes)
1	Start			1
2	Dry Cycle	80	23.9 / 75	33
3	Dry Cycle	80	29.4 / 85	33
4	Dry Cycle	80	35 / 95	33
5	Dry Cycle	80	40.6 / 105	33
6	Dry Cycle	80	46.1 / 115	33
7	Dry Cycle	80	51.7 / 125	33
8	Dry Cycle	80	57.2 / 135	33
9	Dry Cycle	80	62.8 / 145	33
10	Dry Cycle	80	65.6 / 150	33
11	Stop			1

(Gragg et al., 2019)

SIMULATING A HOT SCHOOL BUS

FoodHandler®

- Phase two: Identifying highest risk packing scenarios
  - Temperature profiled in sack lunches subjected to ECTPU program under following conditions:
    - Ice layered on bottom, middle, and top of cooler interior
    - Ice layered on top of cooler interior
    - Ice layered on bottom of cooler interior
    - Ice layered on top and bottom of cooler interior
    - No ice in cooler

Highest risk packing scenarios based upon preliminary temperature testing

(Gragg et al., 2019)

MATERIALS AND METHODS

- Carrots, lunchmeat, and apple slices inoculated with *Salmonella* and *Listeria monocytogenes*
  - Packaged in plastic bags and stored in brown paper bags
  - Non-inoculated sack lunches also prepared to fill cooler to 30 total
  - Seven inoculated lunches were prepared for each pathogen
    - Inoculated control sack lunch not packed in either cooler
- Coolers subjected to ECTPU program & then sampled

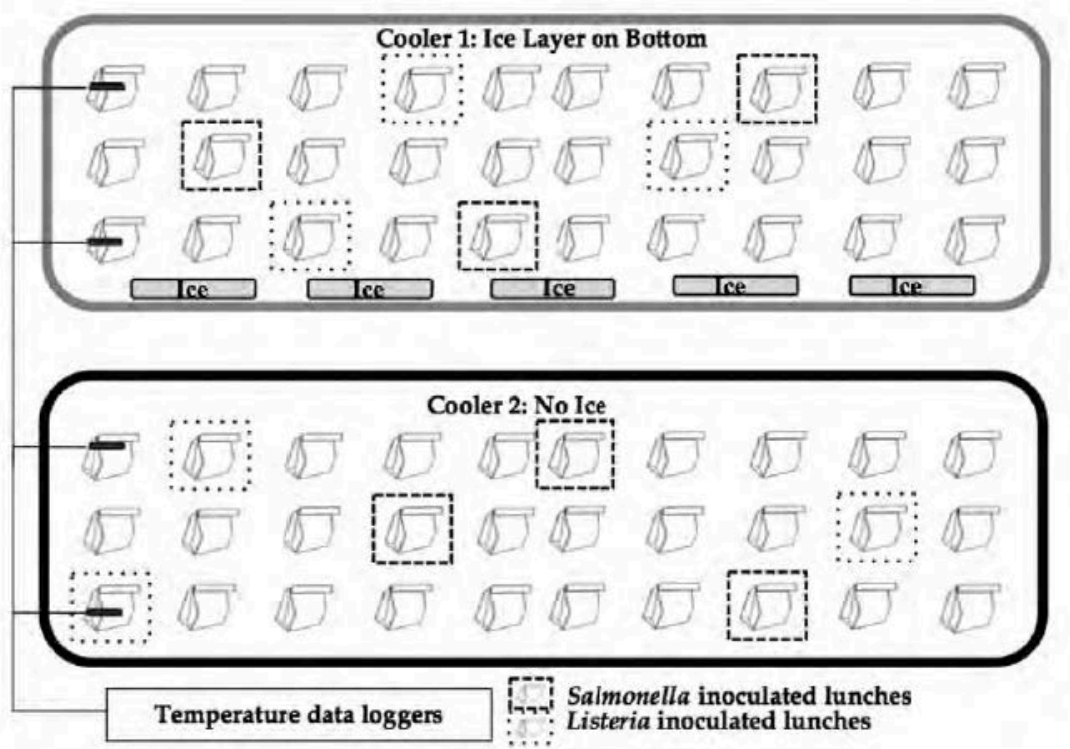


Figure 1. Cooler packing scenarios. Inoculated lunches were randomly assigned to a position within each layer of the cooler.

(Gragg et al., 2019)

TEMPERATURE RESULTS

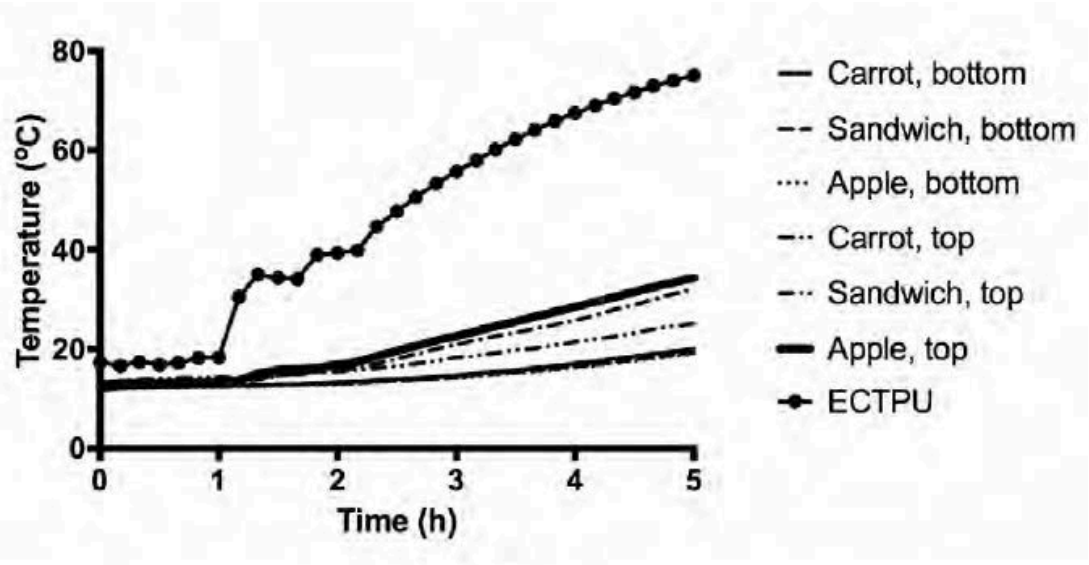


Figure 2. Exposure temperature for turkey sandwiches, sliced apples, and baby carrots packed in a cooler with no ice. Values represent the average temperature of three replications.

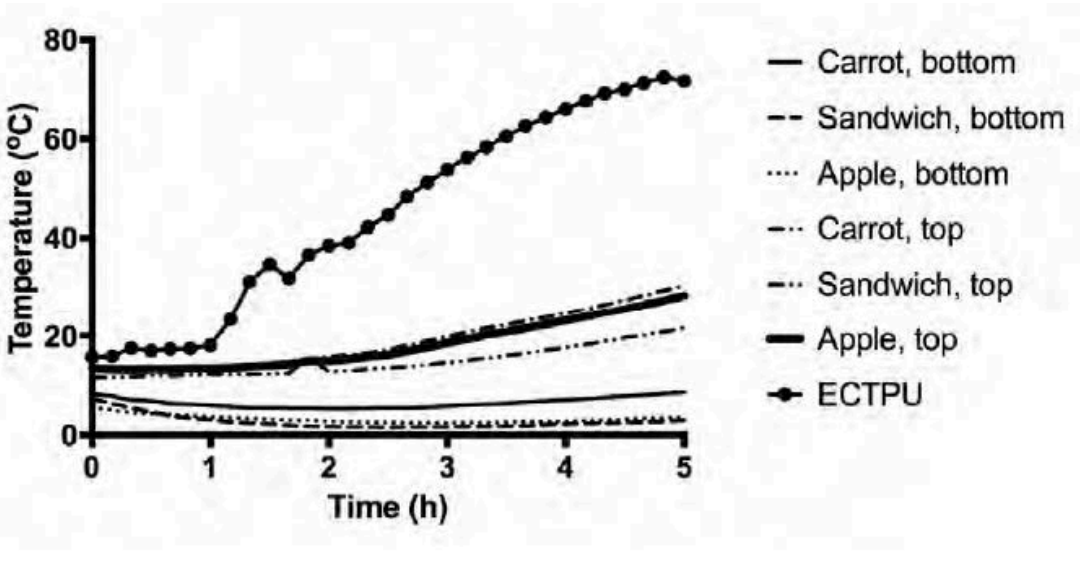


Figure 3. Exposure temperature for turkey sandwiches, sliced apples, and baby carrots packed in a cooler with a layer of ice on the bottom. Values represent the average temperature of three replications.

(Gragg et al., 2019)

PATHOGEN RESULTS

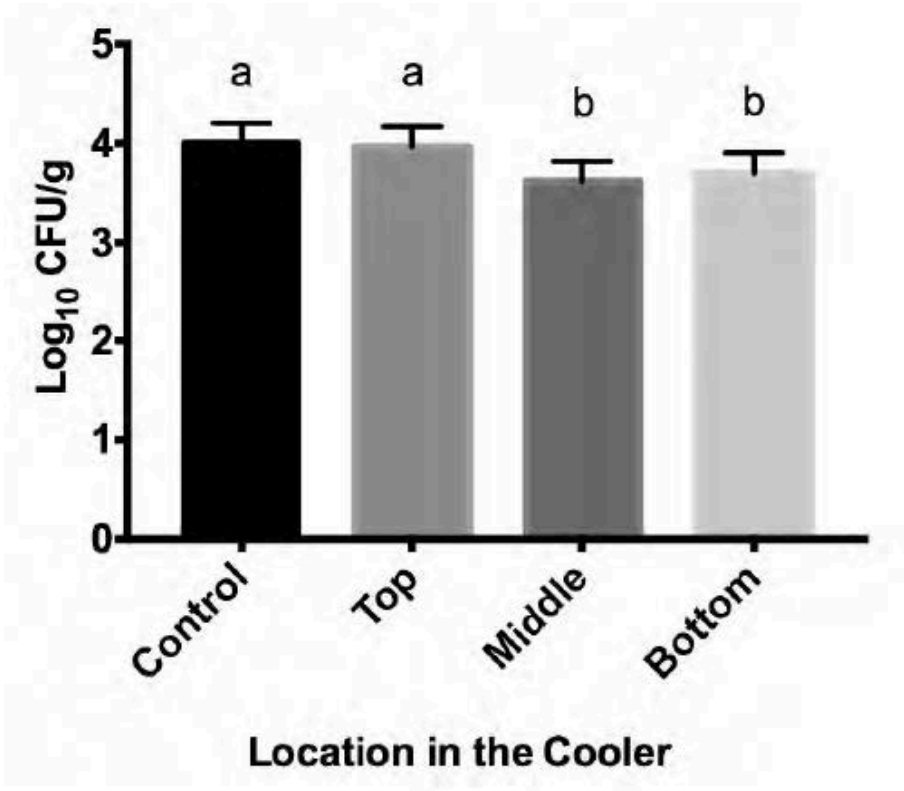


Figure 4. *Salmonella* populations on baby carrots according to their location within the cooler.
*Error bars represent the standard error of the mean.
[a,b]Populations with different superscripts ($P \leq 0.05$) are significantly different.

No other pathogen data were significant

(Gragg et al., 2019)

SUMMARY OF FINDINGS

FoodHandler®

- Temperature data suggests risk for pathogen growth exists
- *Listeria monocytogenes* populations did not vary
- *Salmonella* populations did vary based on location in the cooler
  - Did not exceed the control = no growth
- Cooler type (bottom layer of ice vs. no ice) did not impact pathogens
- When storing sack lunches on field trips:
  - Data support the FDA Food Code (2017)
    - Time can be used as a public health control for a maximum of four hours
  - DATA ARE LIMITED IN SCOPE!
    - Other pathogens and food products must be investigated

(Gragg et al., 2019)

RECOMMENDATIONS

- Store sack lunches in insulated coolers
  - One or more layers of ice
- Minimize amount of time food is exposed to the temperature danger zone
- Avoid storing coolers on school buses with elevated internal temperatures
- Do NOT extrapolate these data to other pathogens or food products

(Gragg et al., 2019)

SafeBites® from FoodHandler

Objective 4:

Describe the bacterial risks associated with improper cooling and discuss research related to the safety of common foodservice cooling methods

PEER-REVIEWED ARTICLE

Food Protection Trends, Vol 39, No. 3, p. 200–211

6200 Aurora Ave., Suite 200W, Des Moines, IA 50322-2864

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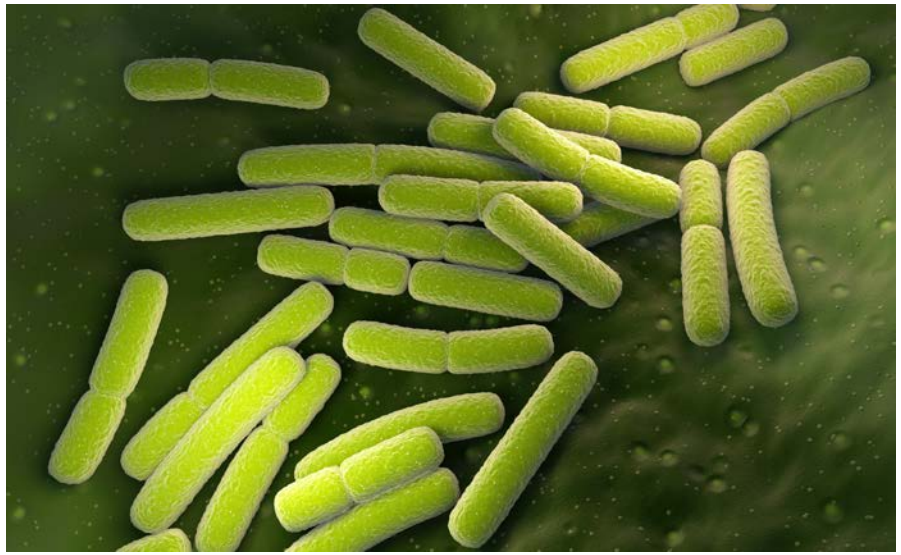
Control of Surrogate *Escherichia coli* Populations in Three Food Products Using Common Food Service Cooling Methods

STUDY OBJECTIVE

- Evaluate cooling methods commonly used in school nutrition programs to determine the impact on *Escherichia coli* populations in low-sodium marinara sauce, taco meat, and chili con carne with beans over a 24-hour period.



(Beardall et al., 2019b)

STUDY VARIABLES

- Hotel Pan Depth
  - 2 inch
  - 3 inch
- Pan Cover
  - Single cover of aluminum foil
  - Double cover of aluminum foil (no air exposure)
  - Uncovered
- Cooling Method
  - Ice water bath in refrigerator (4^{o}C)
  - Freezer (-20^{o}C)

(Beardall et al., 2019b)

MATERIALS AND METHODS

- Canned low-sodium marinara and pre-prepared taco meat
  - Cooked to 73.9°C
- Chili con carne with beans prepared using School Nutrition Program recipe
  - Cooked to 73.9°C
- Products inoculated with *E. coli*, pans prepared according to their treatment (*e.g.* cover vs. no cover), fitted with temperature data logger, and placed in the refrigerator or freezer
- Pans were sampled at 0, 4, 8, 12, and 24 hours of cooling
- Continuous temperature measurements via data logger

(Beardall et al., 2019b)

TEMPERATURE RESULTS

FoodHandler®

The following were generally observed:

- More consistent cooling in freezer and to lower temperatures
- 2-inch pans cooled more quickly than 3-inch pans
- Pans left uncovered cooled the fastest
- 3-inch pans stored in refrigerator with an ice bath cooled faster in first 4 hours than 3-inch pans stored in freezer
  - Storage in freezer more effective after 4-5 hours

(Beardall et al., 2019b)

TABLE 1. Cooling technique combinations that achieved FDA Food Code criteria for pre-cooked taco meat, chili con carne with beans, and marinara sauce

	Pre-Cooked Taco Meat		Chili con Carne with Beans		Marinara Sauce	
Cooling Technique Combination	2 hours	6 hours	2 hours	6 hours	2 hours	6 hours
2-inch Refrigerated ice bath Single cover			✓			
2-inch Refrigerated ice bath Double cover						
2-inch Refrigerated ice bath Uncovered			✓	✓	✓	
3-inch Refrigerated ice bath Single cover						
3-inch Refrigerated ice bath Double cover						
3-inch Refrigerated ice bath Uncovered	✓	✓	✓	✓		
2-inch, freezer Single cover		✓		✓		✓
2-inch, freezer Double cover		✓		✓		✓
2-inch, freezer Uncovered	✓	✓	✓	✓		✓
3-inch, freezer Single cover						
3-inch, freezer Double cover						
3-inch, freezer Uncovered		✓		✓		✓

(Beardall et al., 2019b)

TACO MEAT RESULTS

- *E. coli* populations were not impacted by:
  - Cover type
  - Cooling method (refrigerator vs. freezer)
  - Product depth (2 vs. 3 inch)
- *E. coli* populations did change according to time
  - Declined by 0.2 logs between 0 and 24 hours

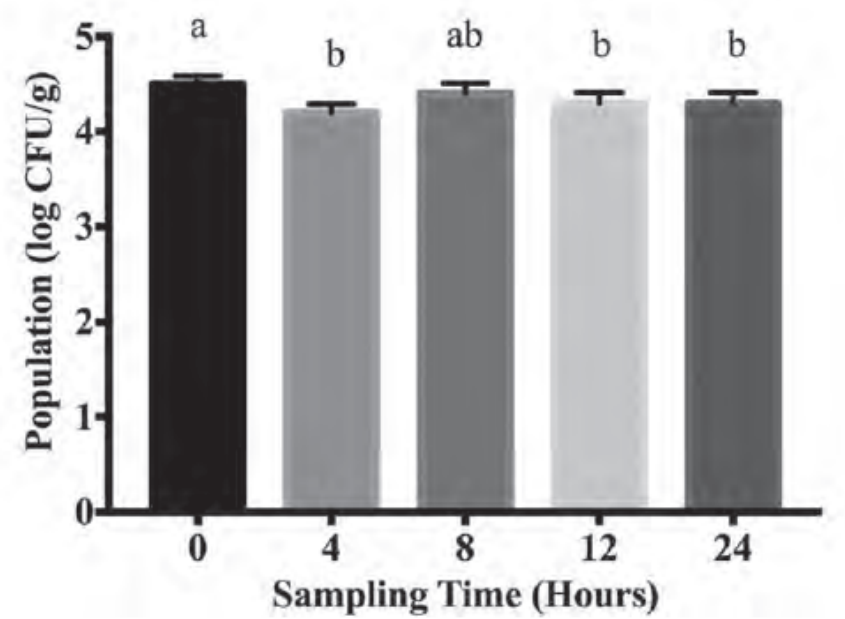


FIGURE 4. Surrogate *Escherichia coli* populations (log_{10} CFU/g) in pre-cooked taco meat analyzed by time. Time was the only significant variable ($P = 0.0022$). Therefore, data associated with all cover types, depth, and storage location are displayed as time alone.
[a–c]Different superscripts indicate statistically significant differences.
Error bars represent the standard error of the mean.

(Beardall et al., 2019b)

CHILI CON CARNE WITH BEANS RESULTS

FoodHandler®

- *E. coli* populations were not impacted by:
  - Cover type
  - Cooling method (refrigerator vs. freezer)
- *E. coli* populations did change according to depth and time
  - Largest change of ~0.3 logs between 0-4 hours

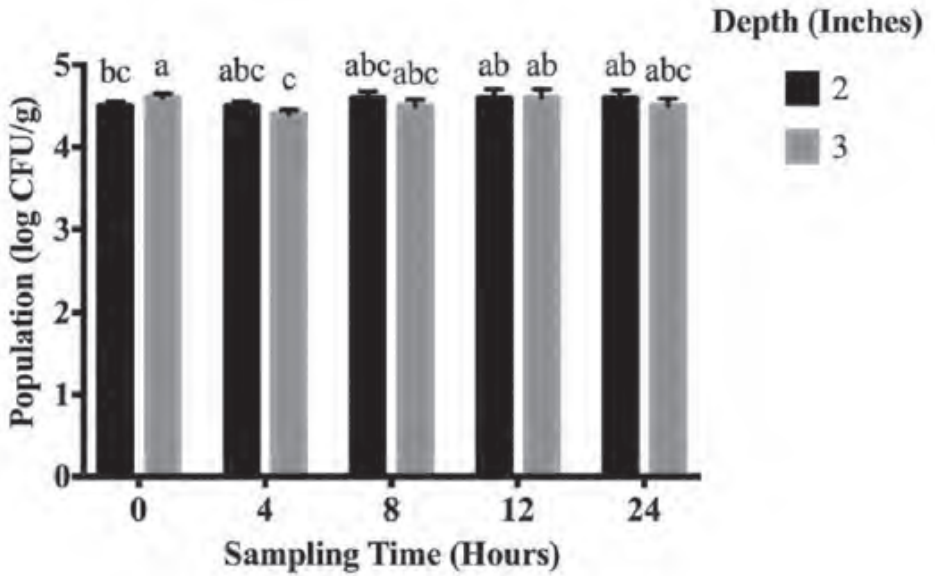


FIGURE 5. Surrogate *Escherichia coli* populations (log_{10} CFU/g) in chili con carne with beans analyzed by product depth and time. The depth by time interaction was significant ($P = 0.0197$). Therefore, data associated with all cover types and storage locations are displayed as product depth and time. Time was a significant variable ($P = 0.0015$), but data are not presented as time alone because of the depth by time interaction.
[a,b,c]Different superscripts indicate statistically significant differences.
Error bars represent the standard error of the mean.

(Beardall et al., 2019b)

LOW SODIUM MARINARA RESULTS

- *E. coli* populations were not impacted by:
  - Cover type
  - Cooling method (refrigerator vs. freezer)
- *E. coli* populations did change according to depth
  - 3-inch depths had lower populations

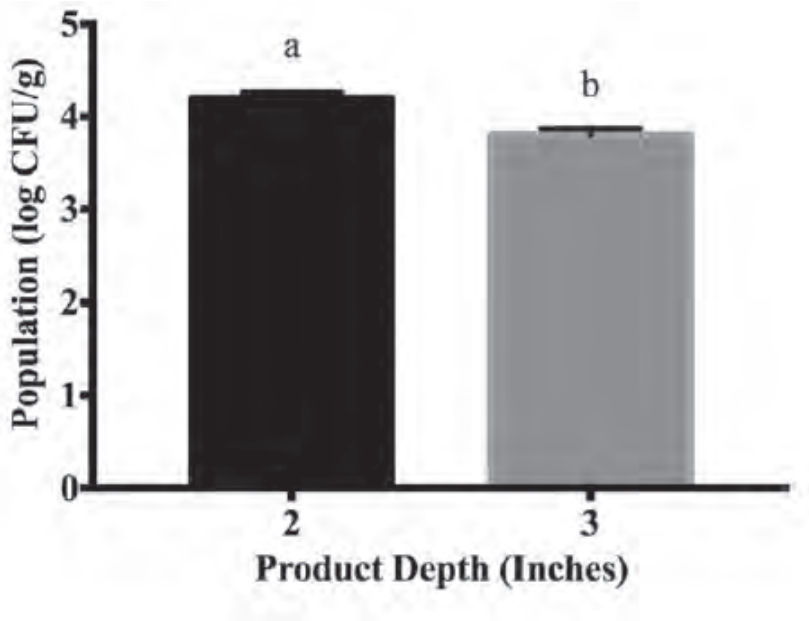


FIGURE 6. Surrogate *Escherichia coli* populations (log_{10} CFU/g) in low-sodium marinara sauce analyzed by product depth. Product depth was significant ($P < 0.0001$). Therefore, data from all time points associated with all cover types and storage location are displayed as depth alone.
[a,b]Different superscripts indicate statistically significant differences.
Error bars represent the standard error of the mean.

(Beardall et al., 2019b)

LOW SODIUM MARINARA RESULTS

FoodHandler®

- *E. coli* populations also change according to time
  - Increase by 0.2 logs between 0 and 8 hours

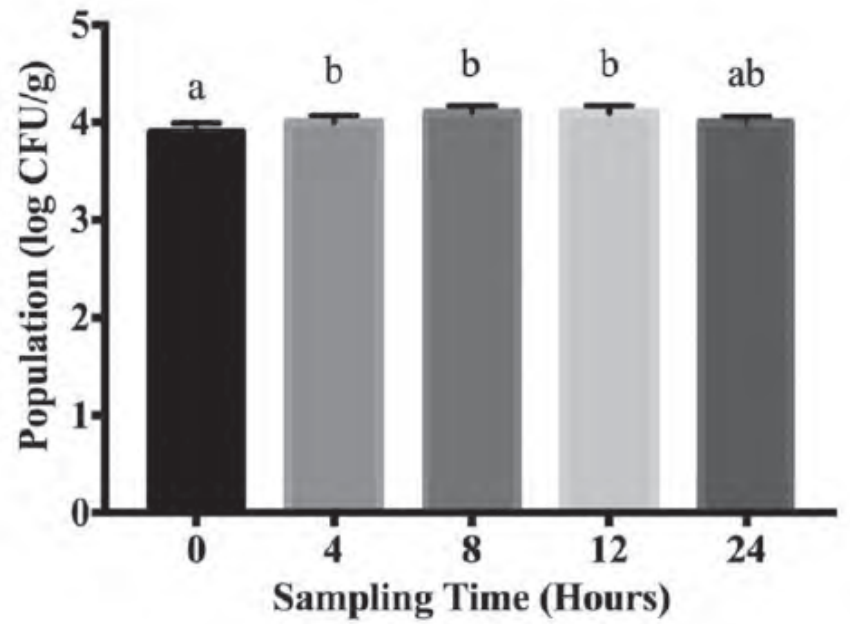


FIGURE 7. Surrogate *Escherichia coli* populations (log_{10} CFU/g) in low-sodium marinara sauce analyzed by time. Time was significant ($P = 0.0312$). Therefore, data associated with all cover types, depth, and storage location are displayed as time alone.
[a,b,c]Different superscripts indicate statistically significant differences.
Error bars represent the standard error of the mean.

(Beardall et al., 2019b)

SUMMARY OF FINDINGS & RECOMMENDATIONS

FoodHandler®

- Equivalent control from all methods
- Effectively controlled *E. coli* populations in all products
  - Despite inability for some methods to achieve 2017 FDA Food Code cooling temperature requirements
- Cooling techniques that **DID** satisfy temperature requirements should be prioritized for use
- DATA ARE LIMITED IN SCOPE!
  - Surrogate *E. coli* merely INDICATE how *E. coli* O157:H7 MIGHT behave
  - Several other food products not evaluated
  - More food/pathogen/cooling combinations should be explored in future

(Beardall et al., 2019b)

Lindsay Beardall,[1] Paola Paez,[2] Randall K. Phebus,[3] Tracee Watkins[2] and Sara E. Gragg[1*]

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PEER-REVIEWED ARTICLE

Food Protection Trends, Vol 39, No. 2, p. 145–153

6200 Aurora Ave., Suite 200W, Des Moines, IA 50322-2864

Control of *Bacillus cereus* Populations in Brown Rice by Use of Common Foodservice Cooling Methods

STUDY OBJECTIVE

- Evaluate cooling methods commonly used in school nutrition programs to determine the impact on *Bacillus cereus* populations in brown rice over a 24-hour period.

(Beardall et al., 2019a)

MATERIALS AND METHODS

- The same general methods were followed as previously discussed
- Brown rice was prepared according to package directions
  - Satisfied School Nutrition Program nutritional standards
- Inoculated with heat-shocked *B. cereus* spores after cooking
  - Heat-shocking simulated the cooking process

(Beardall et al., 2019a)

Temperature Results

The following were generally observed:

- More consistent cooling in freezer and to lower temperatures
- 2-inch pans cooled more quickly than 3-inch pans
- 3-inch pans stored in refrigerator with an ice bath cooled faster in first 4 hours than 3-inch pans stored in freezer
  - Storage in freezer more effective after 4-5 hours

(Beardall et al., 2019a)

TABLE 1. Brown rice cooling technique combinations that achieved FDA Food Code criteria

	57°C to 21°C	Limits		57°C to 5°C	Limits	
		Lower	Upper		Lower	Upper
Cooling Technique Combination	(135°F to 70°F) 2 hours			(135°F to 41°F) 6 hours		
2-inch						
Refrigerated ice bath	13.65°C ✓	6.37°C	20.93°C	6.18°C	-0.77°C	13.09°C
Single cover	(56.57°F)	(43.47°F)	(69.67°F)	(43.12°F)	(30.61°F)	(55.57°F)
2-inch						
Refrigerated ice bath	20.94°C ✓	13.67°C	28.22°C	8.43°C	1.51°C	15.33°C
Double cover	(69.69°F)	(56.61°F)	(82.80°F)	(47.17°F)	(34.72°F)	(59.60°F)
2-inch						
Refrigerated ice bath	9.46°C ✓	2.18°C	16.74°C	4.06°C ✓	-2.86°C	10.96°C
Uncovered*	(49.03°F)	(35.92°F)	(62.13°F)	(39.31°F)	(26.86°F)	(51.74°F)
3-inch						
Refrigerated ice bath	20.02°C ✓	12.74°C	27.29°C	9.06°C	2.14°C	15.97°C
Single cover	(68.04°F)	(54.93°F)	(81.12°F)	(48.31°F)	(35.86°F)	(60.74°F)
3-inch						
Refrigerated ice bath	24.20°C	16.92°C	31.48°C	9.74°C	2.82°C	16.56°C
Double cover	(75.56°F)	(62.46°F)	(88.66°F)	(49.53°F)	(37.08°F)	(61.81°F)
3-inch						
Refrigerated ice bath	8.94°C ✓	1.66°C	16.22°C	1.76°C ✓	-5.16°C	8.67°C
Uncovered*	(48.09°F)	(34.99°F)	(61.20°F)	(35.17°F)	(22.72°F)	(47.61°F)
2-inch, freezer	20.32°C ✓	13.03°C	27.59°C	1.37°C ✓	-5.54°C	8.26°C
Single cover*	(68.58°F)	(55.45°F)	(81.66°F)	(34.47°F)	(22.02°F)	(46.87°F)
2-inch, freezer	28.86°C	19.94°C	37.77°C	13.21°C	4.94°C	21.53°C
Double cover	(83.95°F)	(67.89°F)	(99.97°F)	(55.78°F)	(40.89°F)	(70.67°F)
2-inch, freezer	10.68°C ✓	3.41°C	17.96°C	0.96°C ✓	-5.95°C	7.87°C
Uncovered*	(51.23°F)	(38.13°F)	(64.33°F)	(33.73°F)	(21.29°F)	(46.17°F)
3-inch, freezer	30.22°C	22.94°C	37.50°C	4.72°C ✓	-2.19°C	11.63°C
Single cover	(86.40°F)	(73.29°F)	(99.50°F)	(40.50°F)	(28.05°F)	(52.94°F)
3-inch, freezer	30.98°C	23.70°C	38.26°C	6.76°C	-0.16°C	13.67°C
Double cover	(87.77°F)	(74.66°F)	(100.87°F)	(44.17°F)	(31.72°F)	(56.61°F)
3-inch, freezer	28.33°C	21.16°C	35.61°C	1.04°C ✓	-5.88°C	7.95°C
Uncovered	(83.00°F)	(70.08°F)	(96.10°F)	(33.87°F)	(21.42°F)	(46.31°F)

*Indicates cooling method achieved both FDA Food Code criteria.

BROWN RICE RESULTS

- *B. cereus* populations were not impacted by cover type
- *B. cereus* populations did change according to storage location and time
  - Changes were less than 0.5 logs throughout storage
  - Populations declined

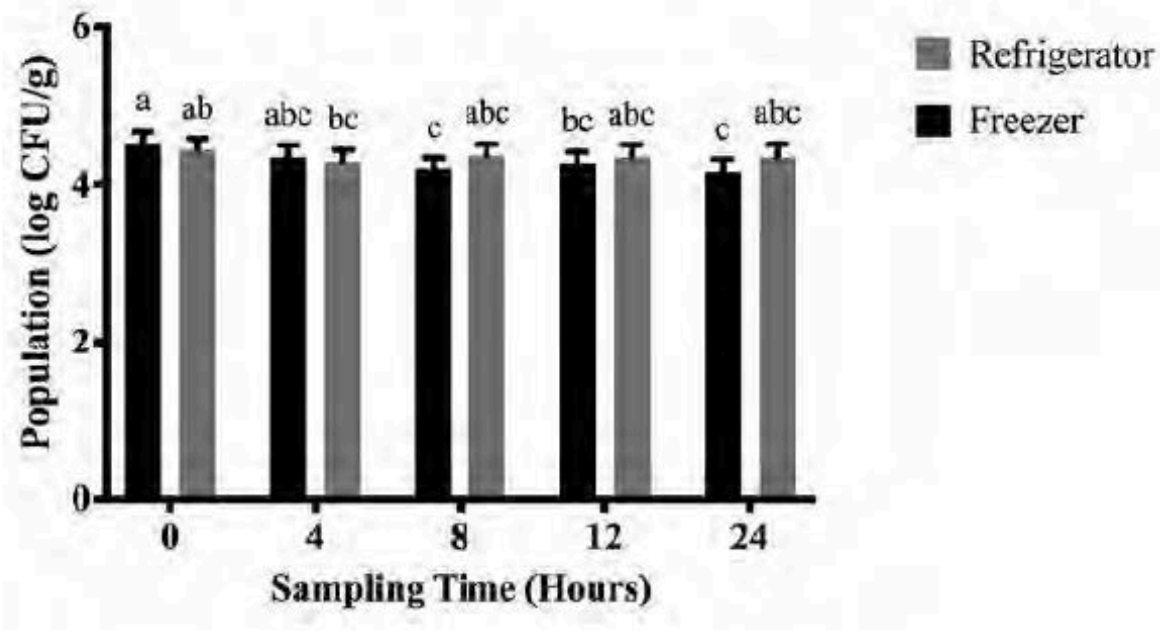

Figure 2. *Bacillus cereus* populations (log_{10} CFU/g) in brown rice analyzed by storage location and time. The storage location × time interaction was significant ($P = 0.0026$) and did not include cover type or depth. Therefore, data associated with all cover types and depths are displayed as storage location and time.

[a,b,c]Different superscripts indicate statistically significant differences.

Error bars represent the standard error of the mean.

(Beardall et al., 2019a)

BROWN RICE RESULTS

- *B. cereus* populations also changed according to depth and time
  - Less than 0.5 logs throughout storage
  - Populations declined

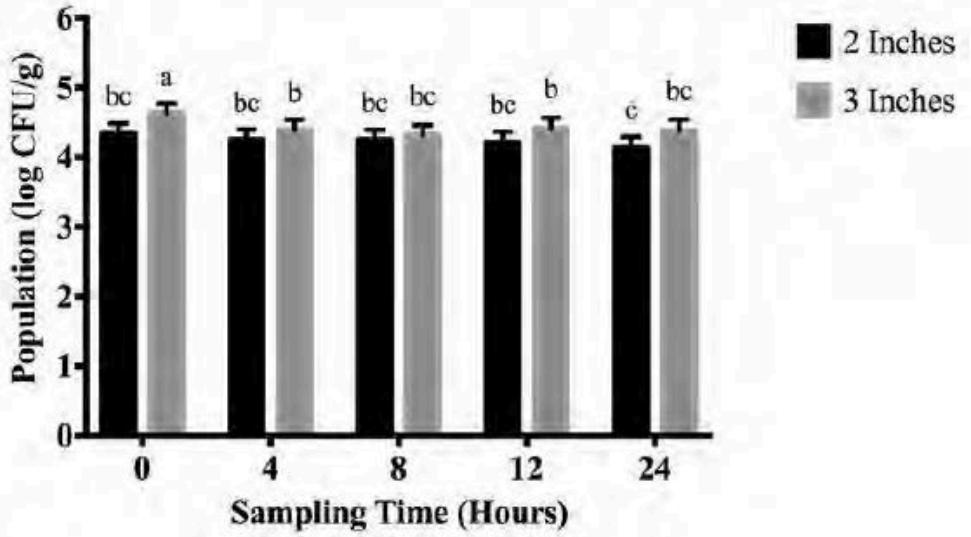

Figure 3. *Bacillus cereus* populations (log_{10} CFU/g) in brown rice analyzed by product depth and time. The storage product depth × time interaction was significant ($P = 0.0268$) and did not include cover type or storage location. Therefore, data associated with all cover types and storage locations are displayed as product depth and time. Product depth was a significant variable ($P = 0.0235$), but data are not presented by depth alone because of the depth × time interaction.

[a,b,c]Different superscripts indicate statistically significant differences.

Error bars represent the standard error of the mean.

(Beardall et al., 2019a)

SUMMARY OF FINDINGS & RECOMMENDATIONS

- Equivalent control from all methods
- Effectively controlled *B. cereus* populations in brown rice
  - Populations declined in this study
    - Small decline that may have been due to natural variability
    - Negligible from a biological sense
  - Despite inability for some methods to achieve 2017 FDA Food Code cooling temperature requirements
- Cooling techniques that **DID** satisfy temperature requirements should be prioritized for use

(Beardall et al., 2019a)

QUESTIONS?

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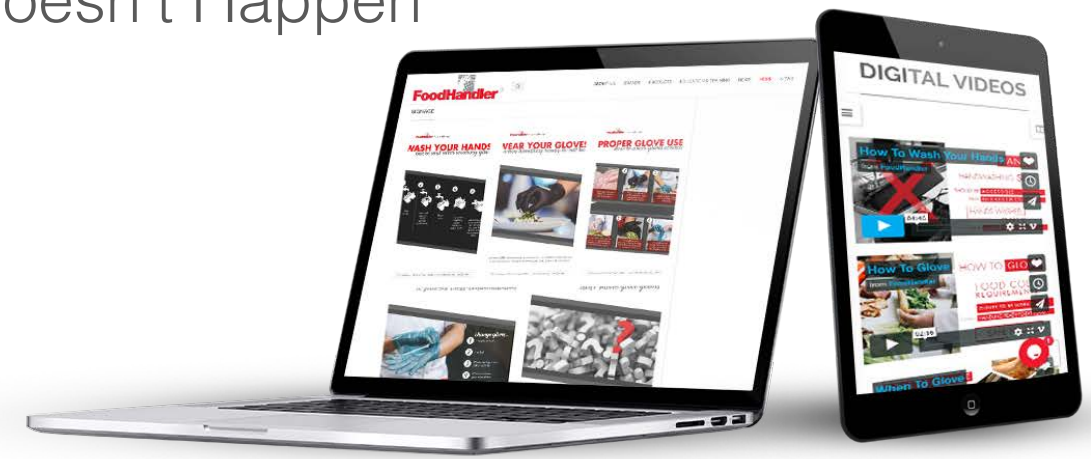
- Handwashing
- Why To Glove
- When To Glove
- How To Glove



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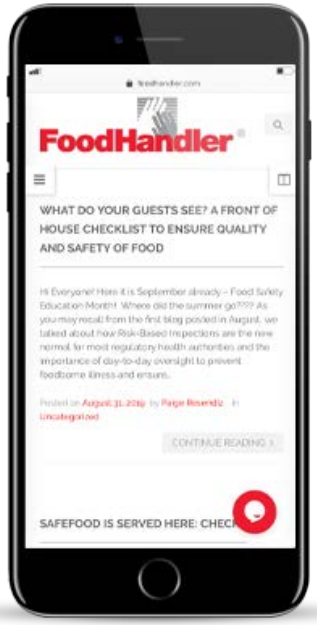

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- Pathogens and the threat to Food Safety

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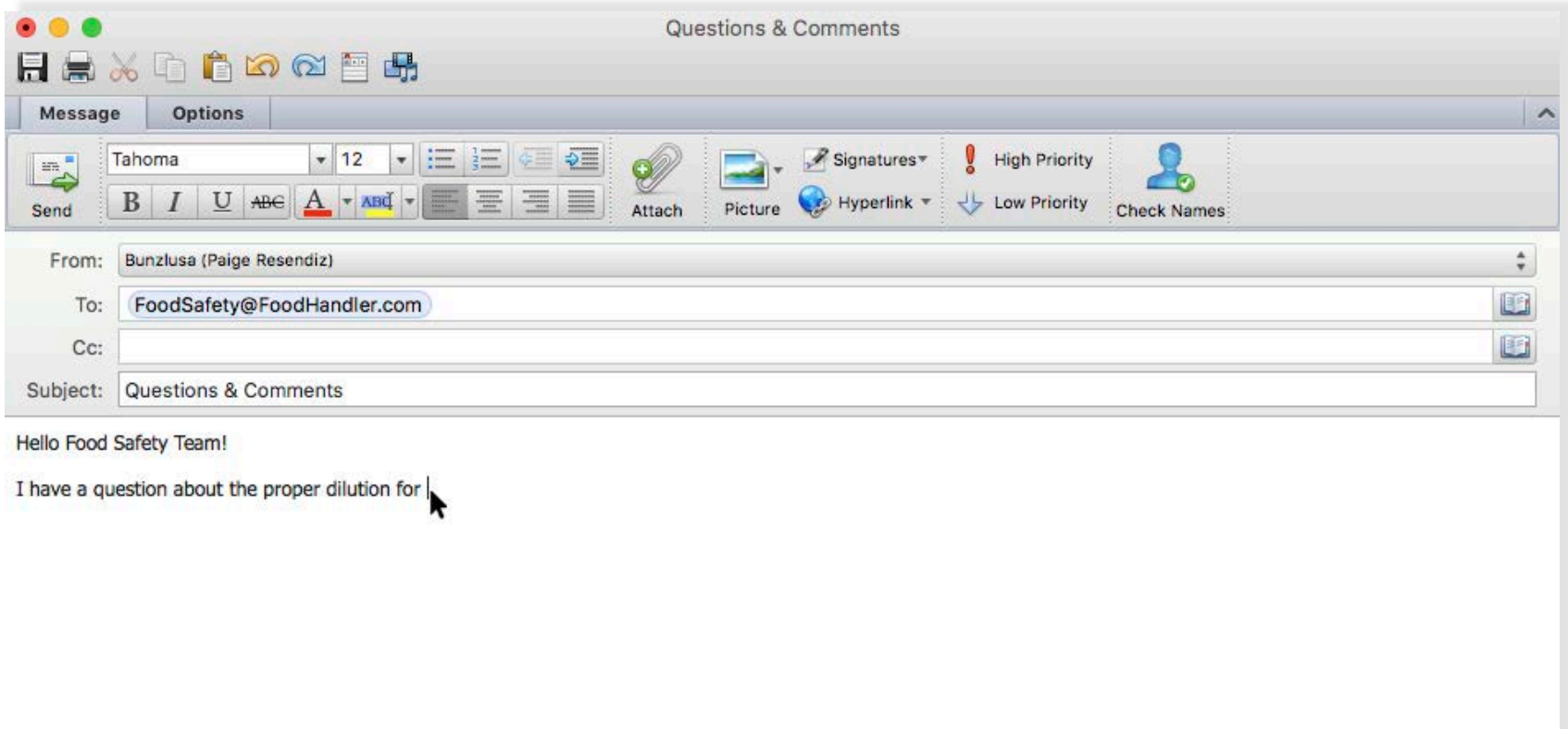

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REFERENCES

- Beardall, L., Paez, P., Phebus, R.K., Watkins, T., Gragg, S.E., 2019a. Control of *Bacillus cereus* Populations in Brown Rice by Use of Common Foodservice Cooling Methods. Food Prot. Trends 39, 145-153.
- Beardall, L., Paez, P., Phebus, R.K., Watkins, T., Gragg, S.E., 2019b. Control of Surrogate *Escherichia coli* Populations in Three Food Products Using Common Food Service Cooling Methods. Food Prot. Trends 39, 200-211.
- Gragg, S.E., Sevart, N.J., Paez, P., Wilder, A., Phebus, R.K., 2019. Simulation of Time and Temperature as a Public Health Control for Food Served during Field Trips. Food Prot. Trends 39, 8-17.
- Matthews, K.R., Kniel, K.E., Montville, T.J., 2017. Food Microbiology : An Introduction, Fourth Edition. ed. ASM Press, Washington, DC.
- Scallan, E., Hoekstra, R.M., Angulo, F.J., Tauxe, R.V., Widdowson, M.A., Roy, S.L., Jones, J.L., Griffin, P.M., 2011a. Foodborne illness acquired in the United States--major pathogens. Emerg. Infect. Dis. 17, 7-15.
- Scallan, E., Griffin, P.M., Angulo, F.J., Tauxe, R.V., Hoekstra, R.M., 2011b. Foodborne illness acquired in the United States--unspecified agents. Emerg. Infect. Dis. 17, 16-22.
- Sneed, J., Patten, E., 2015. Current practices for providing school field trip meals: perspectives of school nutrition managers and teachers. J. Child Nutr. Manag. 39, 1-13.
- United States Department of Agriculture Food and Nutrition Service, 2012. Meal requirements for lunches and requirements for afterschool snacks. 7CFR§210.10.
- United States Food and Drug Administration, 2017. Food Code 2017. https://www.fda.gov/downloads/Food/GuidanceRegulation/RetailFoodProtection/FoodCode/UCM595140.pdf.