



The Center of Excellence for  
**FOOD SAFETY RESEARCH IN  
CHILD NUTRITION PROGRAMS**

# A Simulation Study to Evaluate the Safety of Lunches Stored in Coolers in Extreme School Bus Temperatures

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## Introduction

- Off-Site field trips increase food safety risks due to elevated ambient temperatures and variable holding and service conditions.
- Meals are often prepared as sack lunches, stored in insulated coolers, and taken with teachers and students to the off-site location and stored for two or more hours.
- *Salmonella* and *Listeria monocytogenes* are potential foodborne pathogen risks associated with foods that are often served in sack lunches.
- Thus, off-site field trips present a food safety challenge for school nutrition programs.

## Purpose

When held under conditions that simulate temperatures in an enclosed school bus on a warm day, determine the growth potential of *Listeria monocytogenes* and *Salmonella* spp. in common school lunch foods packed in insulated coolers, with and without ice packs on the bottom.

## Methods

- Ambient temperature profiles were determined using data loggers to record internal and external bus temperatures during May-June 2015 in North Carolina and Arkansas.
- Lunches met NSLP standards, and included a turkey sandwich, sliced apples, and baby carrots.
- Lunches inoculated separately with *L. monocytogenes* or *Salmonella* (ca. 4 log CFU/g; control samples enumerated at time of placement into thermal processing unit)

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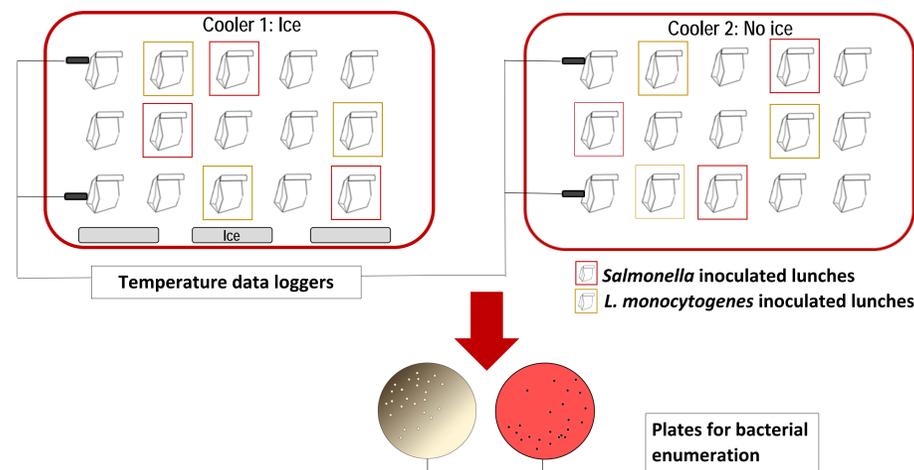


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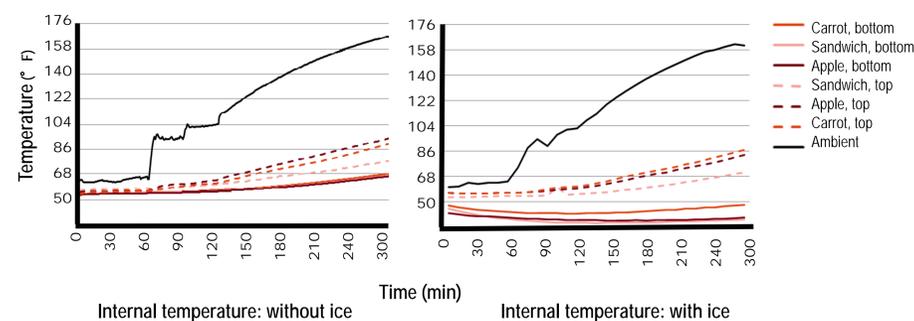
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## Methods

- A sack lunch with each pathogen was randomly placed in the top, middle and bottom layers (10 lunches per layer; total 30 lunches per cooler) in each cooler (with or without ice packs).
- Coolers were subjected to increasing temperatures (75-150°F) for 5 hrs.
- Food temperatures were recorded in lunches in the top and bottom layers.
- Samples from sandwiches, sliced apples, and baby carrots were plated on selective media to enumerate changes in pathogen populations.
- Data analyzed using the SAS MIXED procedure; 3 replications.

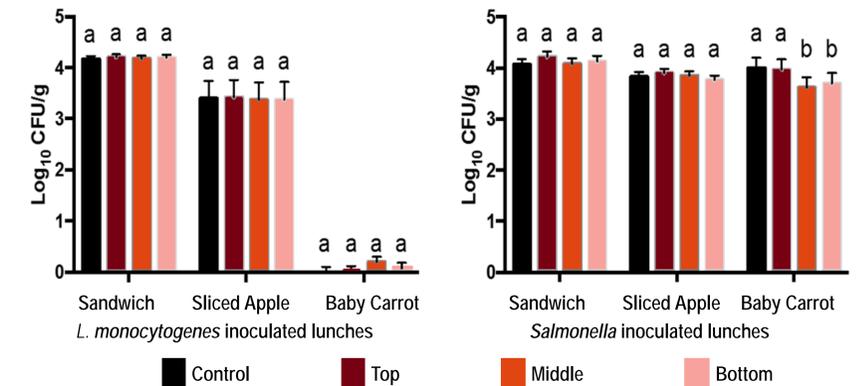


## Results



- In coolers packed without ice, all foods were in the temperature danger zone (TDZ; 41-135°F) for five hours.
- In coolers with ice packs on the bottom, foods in the top layer (and likely the middle layer where temperature was not monitored) were in the TDZ for five hours.

## Results



- No differences ( $P > 0.05$ ) were observed in *L. monocytogenes* or *Salmonella* populations comparing time 0 controls and 5-hour populations between cooler packing scenarios (ice or no ice). Therefore, pathogen recovery graphs above were averaged across packing scenarios.
- Product placement within cooler did not result in *L. monocytogenes* population changes (compared to controls) on sandwiches, sliced apples, or baby carrots.
- *L. monocytogenes* populations were virtually non-recoverable on baby carrots.
- Product placement in coolers did not result in *Salmonella* population changes for sandwiches and sliced apples, but a slight population decline was observed on baby carrots placed in the middle and bottom layers of both cooler packing scenarios ( $P \leq 0.05$ ).
- This study suggests that time  $\leq 5$  hours is an adequate safety control for *Salmonella* and *L. monocytogenes* in the specific foods studied. This may not be the case for other pathogens or food types.

## Applications

- To meet USDA Food Code standards for cold holding, lunches should be packed in insulated coolers with 2-3 layers of ice or ice packs.
- For field trip lunches, foods unlikely to support microbial growth should be selected.
- Child nutrition professionals should be educated about the importance of time and temperature control during field trips.