



MAXWELL CHASE TECHNOLOGIES, LLC

ABSORBENT PACKAGING & EQUIPMENT
A Subsidiary of CSP Technologies, Inc.

**Extending Shelf Life and Reducing
Risk Associated with
Packaging of Fresh Whole and Cut Produce
(Food safe antimicrobial agent)**



CAPABILITIES

- More than 20 years of designing and manufacturing packaging to improve food quality
- Located in Atlanta, GA USA
- Products
 - Absorbent trays, pads, pouches
 - Retail containers, mini containers
 - Complementary semi-automatic & automatic slicers and sealers





KEY PRODUCTS

Inventor of the Fresh-R-Pax® absorbent technology, a proprietary blend of food safe materials

Complies with both FDA and EU Food Contact and Active & Intelligent Packaging Regulations





PROBLEM

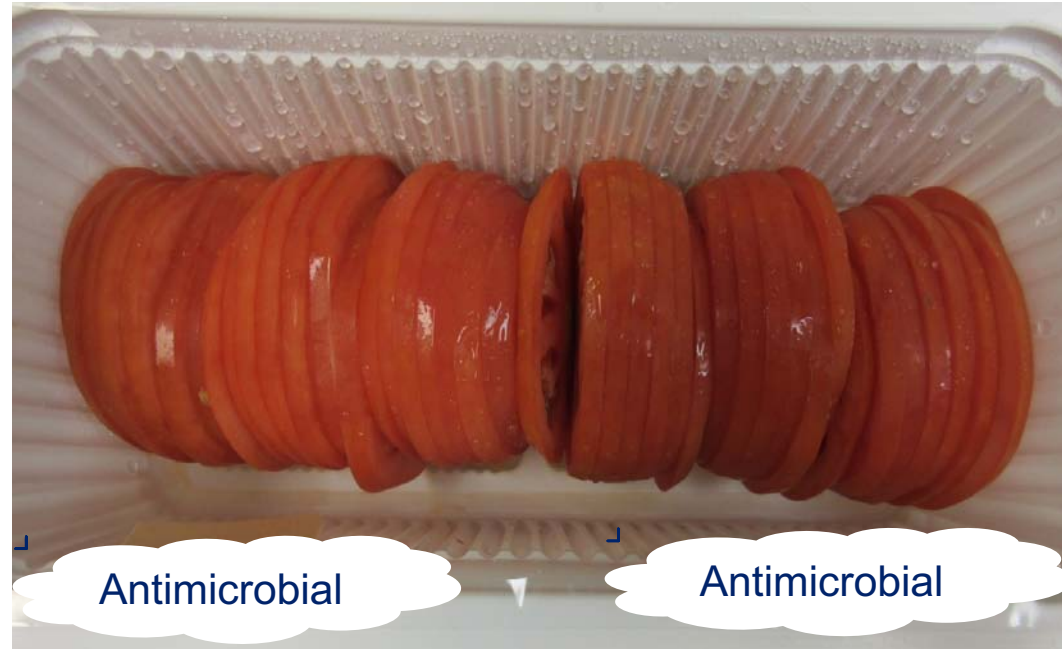
Breakdown in the food handling process and/or cold chain management can allow pathogen growth leading to outbreaks of food borne illness





PROPOSED SOLUTION

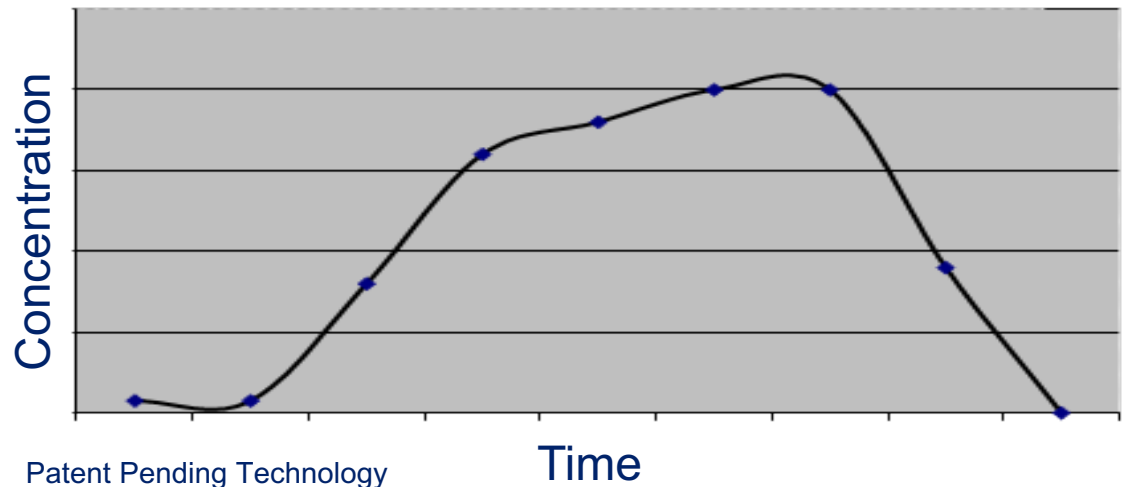
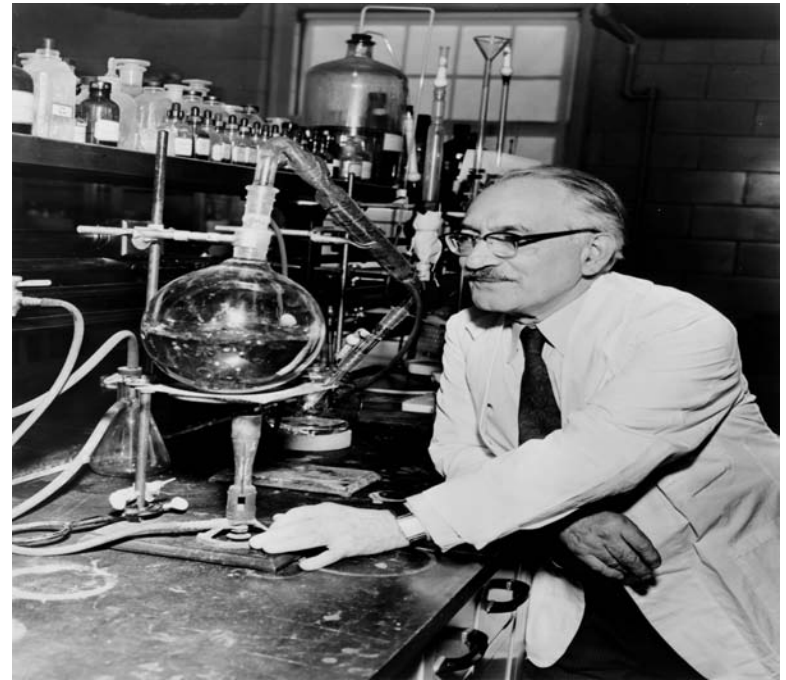
The controlled release of a food safe volatile antimicrobial into the headspace of a package





SELECTING VARIABLES

- Type of antimicrobial
- Headspace concentration
- Release profile
- Storage conditions
- Release location





ANTIMICROBIAL CRITERIA

- Has to volatilize at refrigerated temperatures
- Has to be food safe (edible in its finished form)
- Has to be incorporated safely into release mechanism
- Has to be shelf stable in long term storage conditions
- Has to only release once the product is sealed
- Has to not effect the product organoleptically
- Has to meet all regulations for worldwide food packaging including finished food labeling

Chlorine Dioxide
anti-microbial of choice





CONCENTRATION CRITERIA

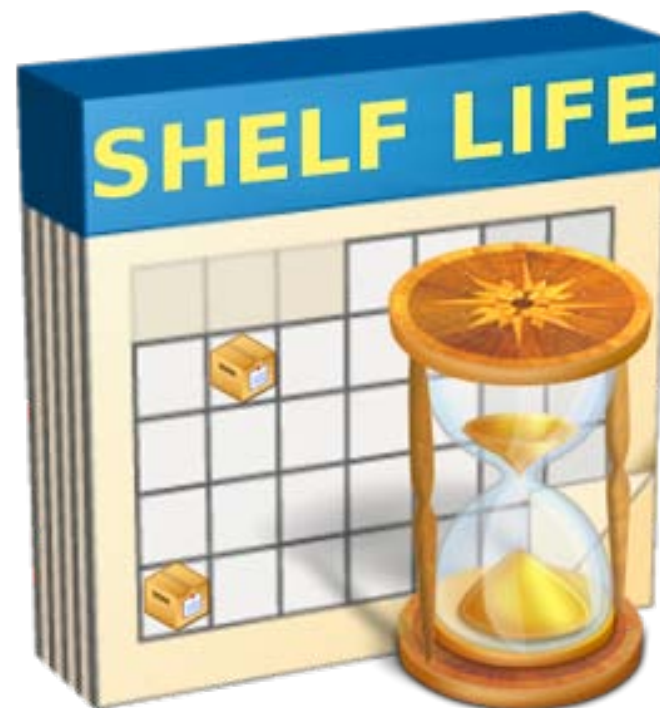
- Sufficient to reduce pathogen levels
- Below the level to create a visual change (bleaching)
- Below the level to impart a noticeable change in aroma
- Maintain levels within regulatory guidelines





RELEASE PROFILE CRITERIA

- Cannot release prematurely (prior to filling)
- Length of release must align with shelf life
- Release profile can be customized for specific food or package





TEST STORAGE CRITERIA

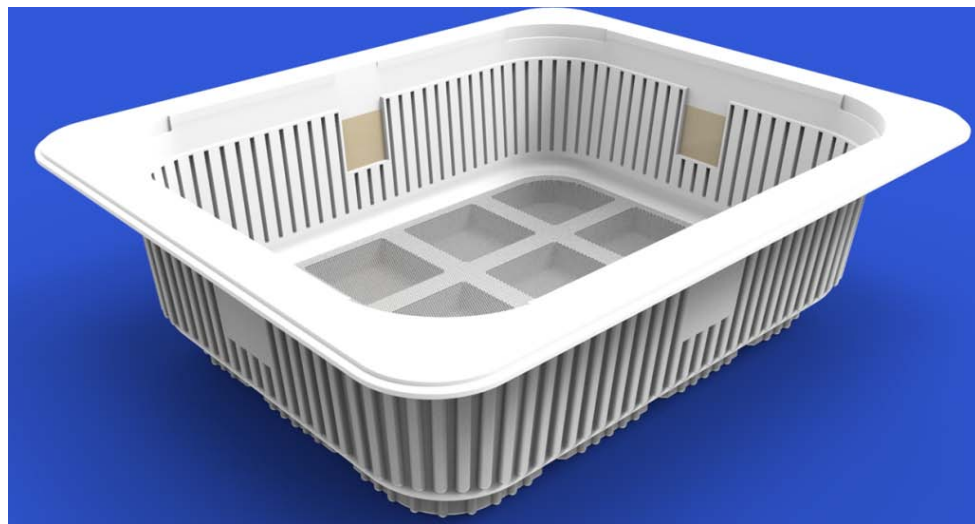
- For initial experiments a temperature was selected that is close to ideal but can allow pathogens to grow.
- 7°C was chosen to in order to replicate when storage temperatures are slightly elevated (or if the product is subjected to a one time spike in temperature)
- Future experiments will use more varied temperatures to explore all the possibilities of storage conditions





FILM PLACEMENT CRITERIA

- Film placement is an important factor.
- Food will absorb the antimicrobial.
- Poor placement will reduce the desired effect.





RESULTS





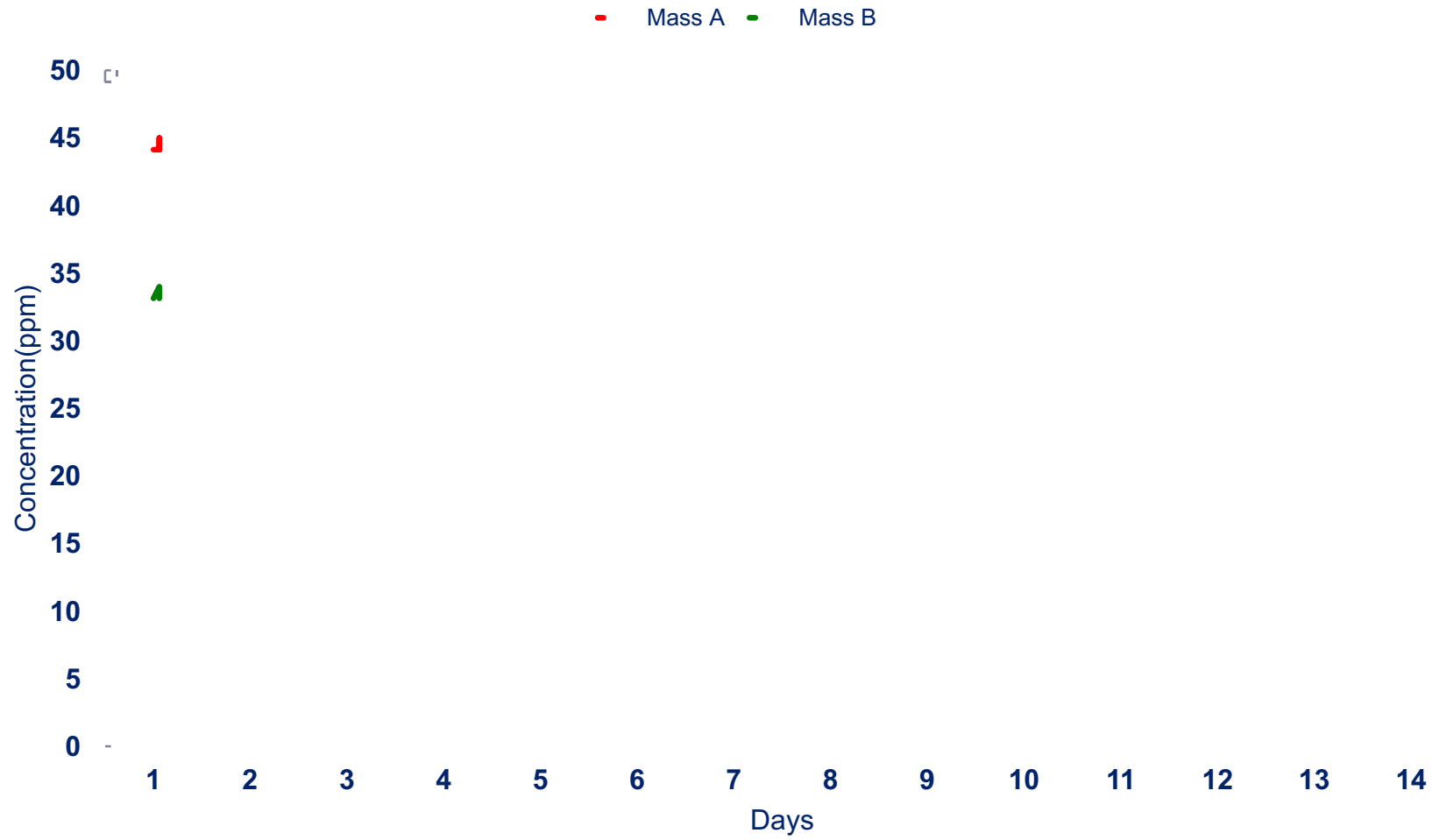
CONCENTRATION TESTING

- ClO₂ levels were measured with detection sensors that would register between the desired concentration known to have an antimicrobial effect on most organisms



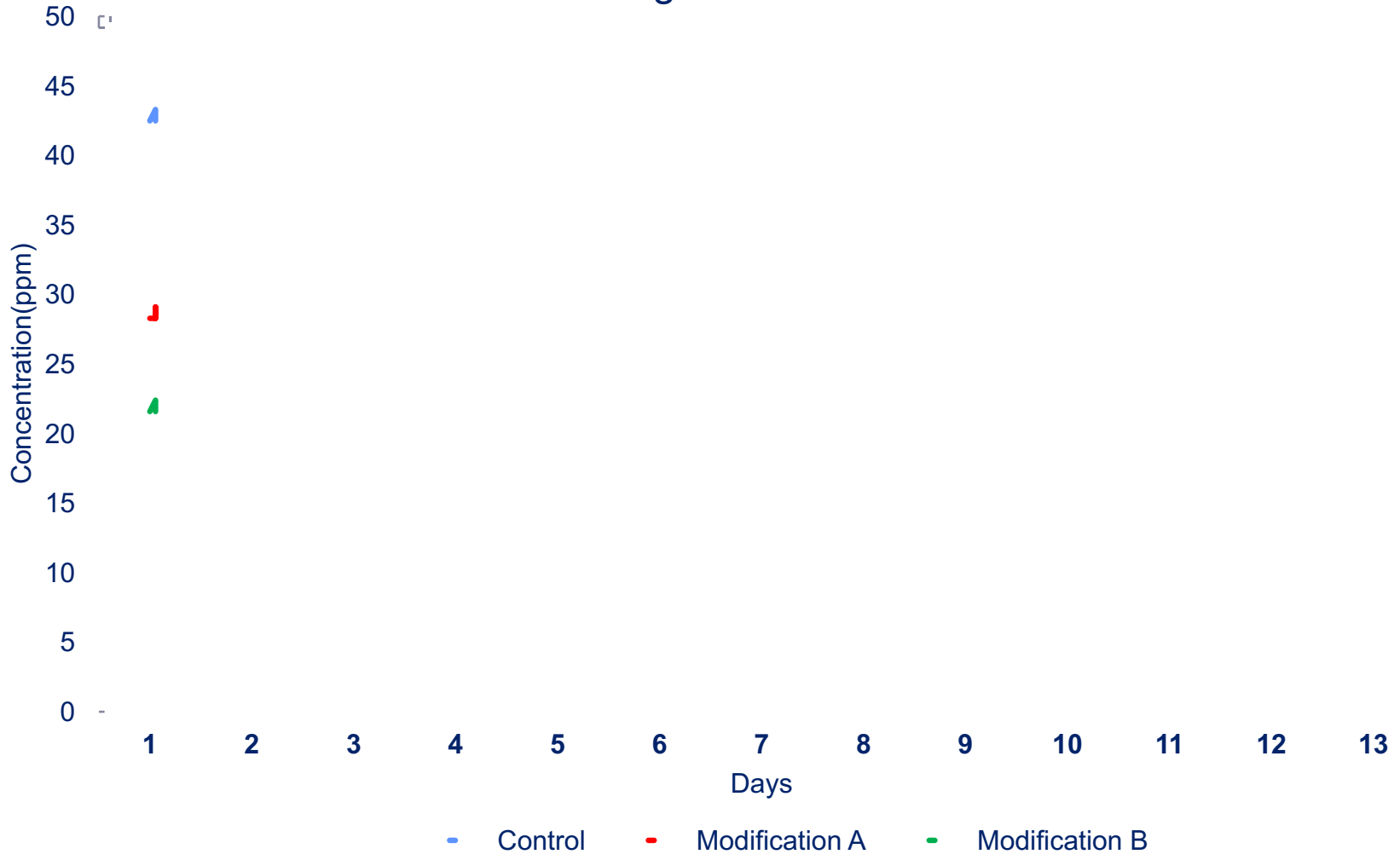


Effect of Change in Mass



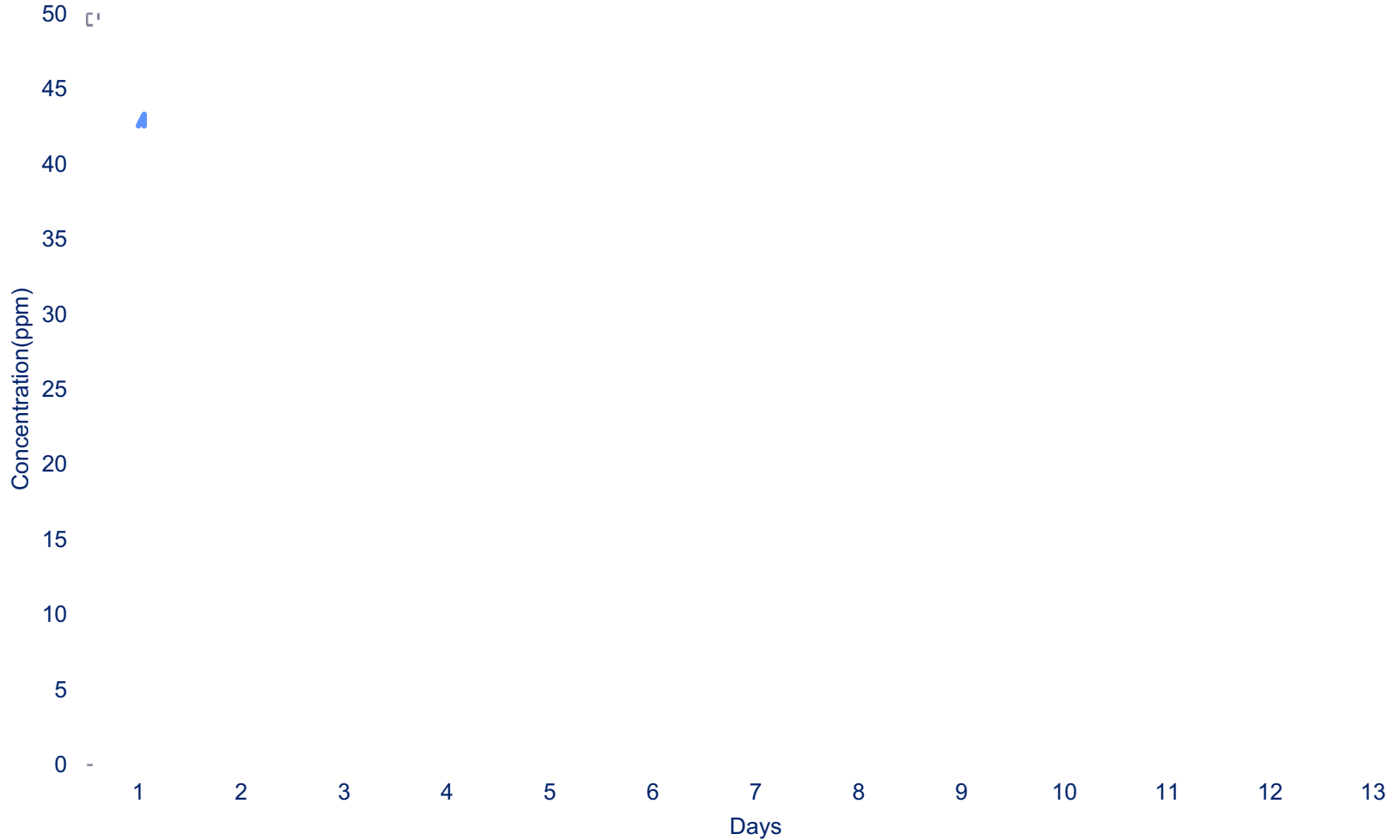


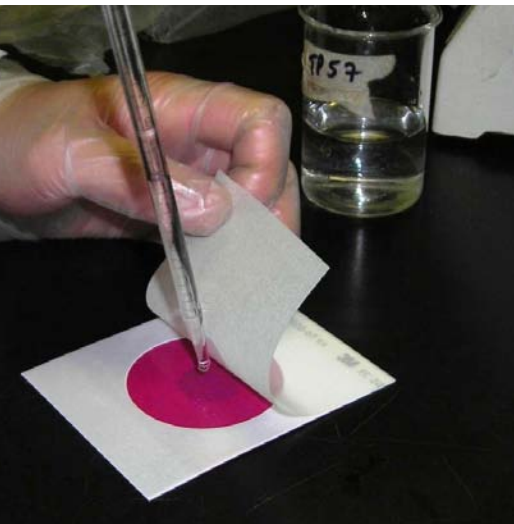
Effect of Change in Release Profile



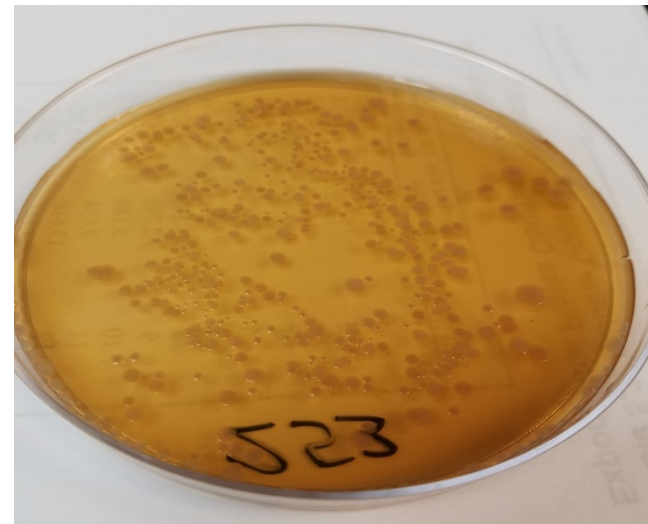
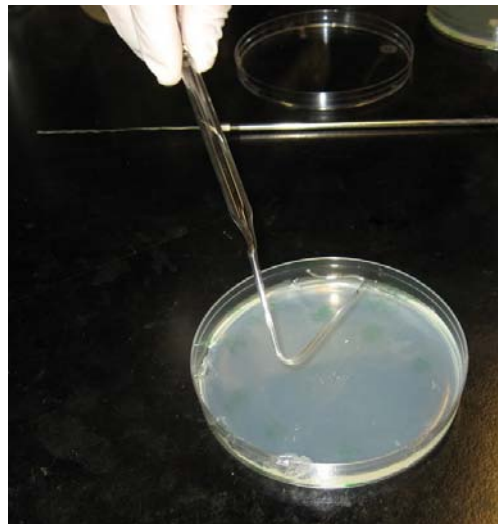


Release Profile used in Studies





OR





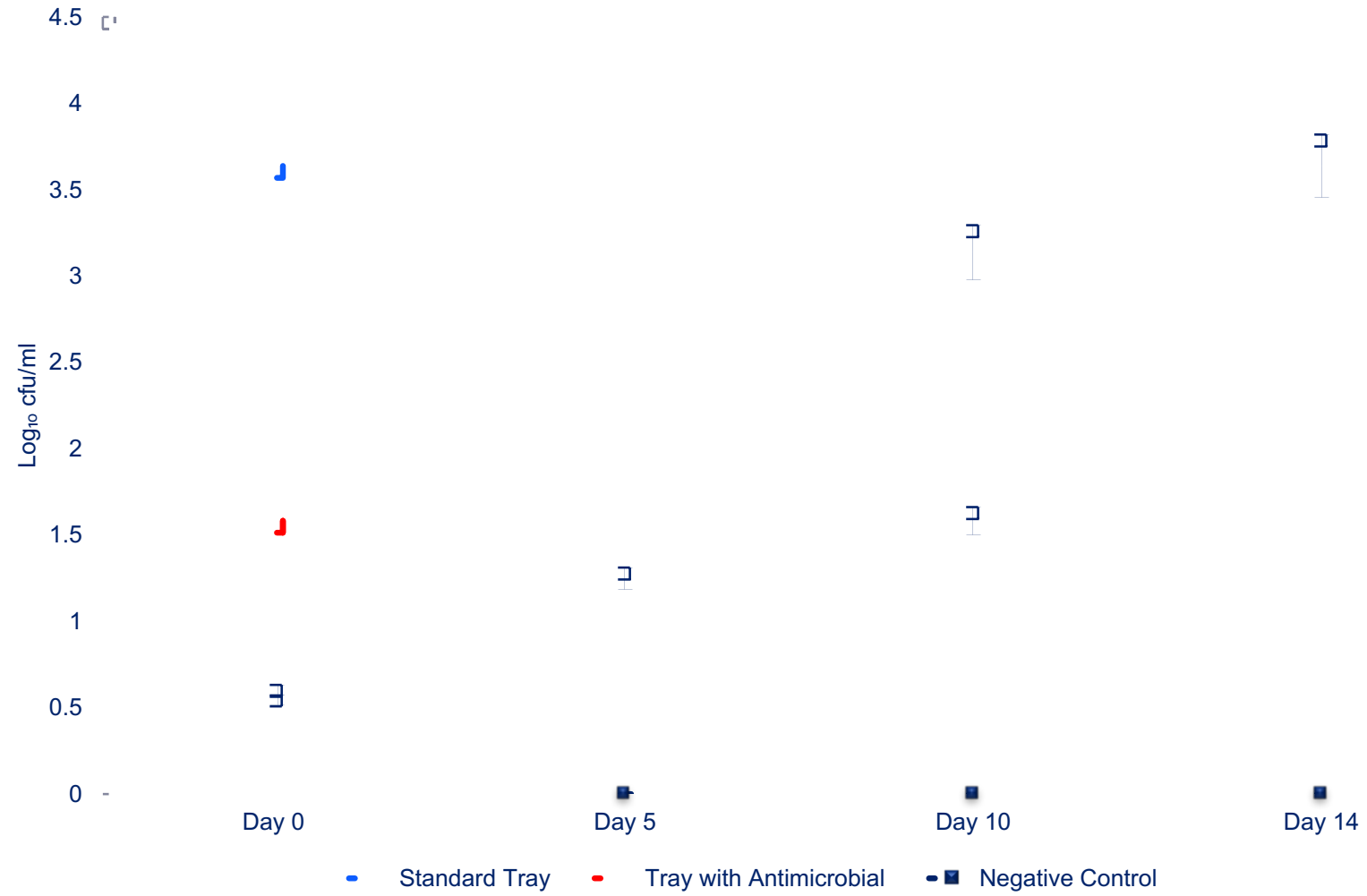
INDICATOR TESTING

- A common cause of rejects for quality issues on tomatoes, is *Geotrichum candidum*, a yeast like mold that grows as a white fuzz
- *G. candidum* was used as an indicator organism to do initial testing and proof of concept before pathogen testing was started at an external laboratory



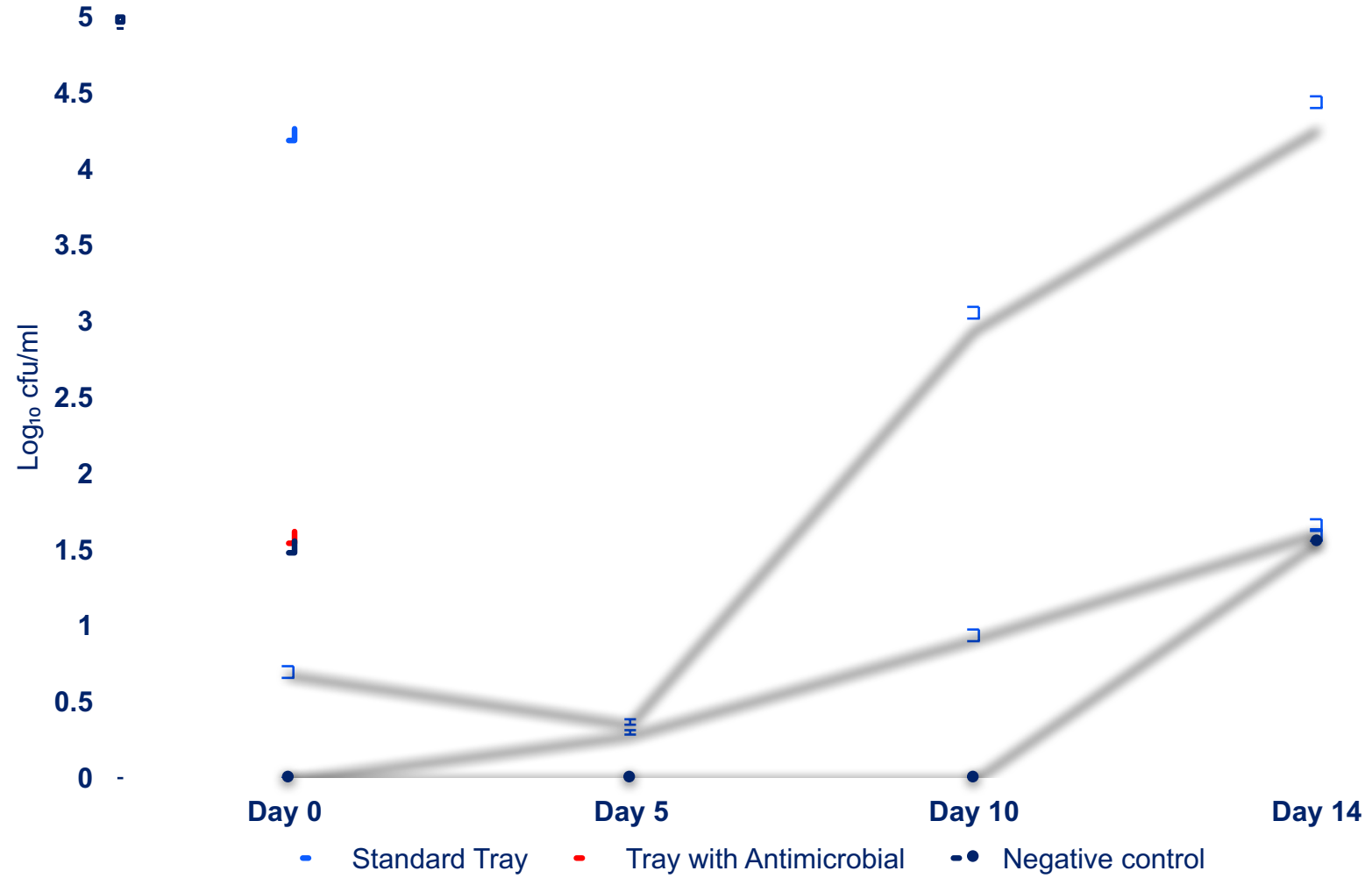


Geotrichum Growth on Sliced Tomatoes at 7°C





Geotrichum Growth on Sliced Tomatoes at 7°C





Geotrichum Growth on Sliced Tomatoes - Day 14



With Antimicrobial Solution



Without Antimicrobial Solution



PATHOGEN TESTING

Three pathogens were selected for initial safety testing for reduction on sliced tomatoes:

- *Salmonella enterica* subsp. *enterica*
- *Escherichia coli* O157:H7
- *Listeria monocytogenes*

As is common in food testing with specific pathogens, a 5 strain cocktail was made for each pathogen type and applied to the tomato slices to imitate either field or equipment contamination





PATHOGENS

5 Strain Cocktails of common Food Pathogens were used:

- *E. coli* O157:H7 (Rifampin resistant)
 - H1730 (lettuce)
 - SEA 13B88 (unpasteurized apple juice)
 - F4546 (1997 alfalfa sprout)
 - CDC 658 (cantaloupe)
 - C7927 (cider)
- *S. enterica* subsp. *enterica* (Nalidixic Acid Resistant)
 - Agona (alfalfa sprout)
 - Baildon (tomato)
 - Montevideo (tomato)
 - Gaminara (orange juice)
 - Poona (cantaloupe)
- *L. monocytogenes*
 - F8027 (serotype 4b, from celery)
 - F8255 (serotype 1/2b, from peach)
 - F8369 (serotype 1/2a, from corn)
 - G1091 (serotype 4b, from coleslaw)
 - H0222 (serotype 1/2a, from potato)

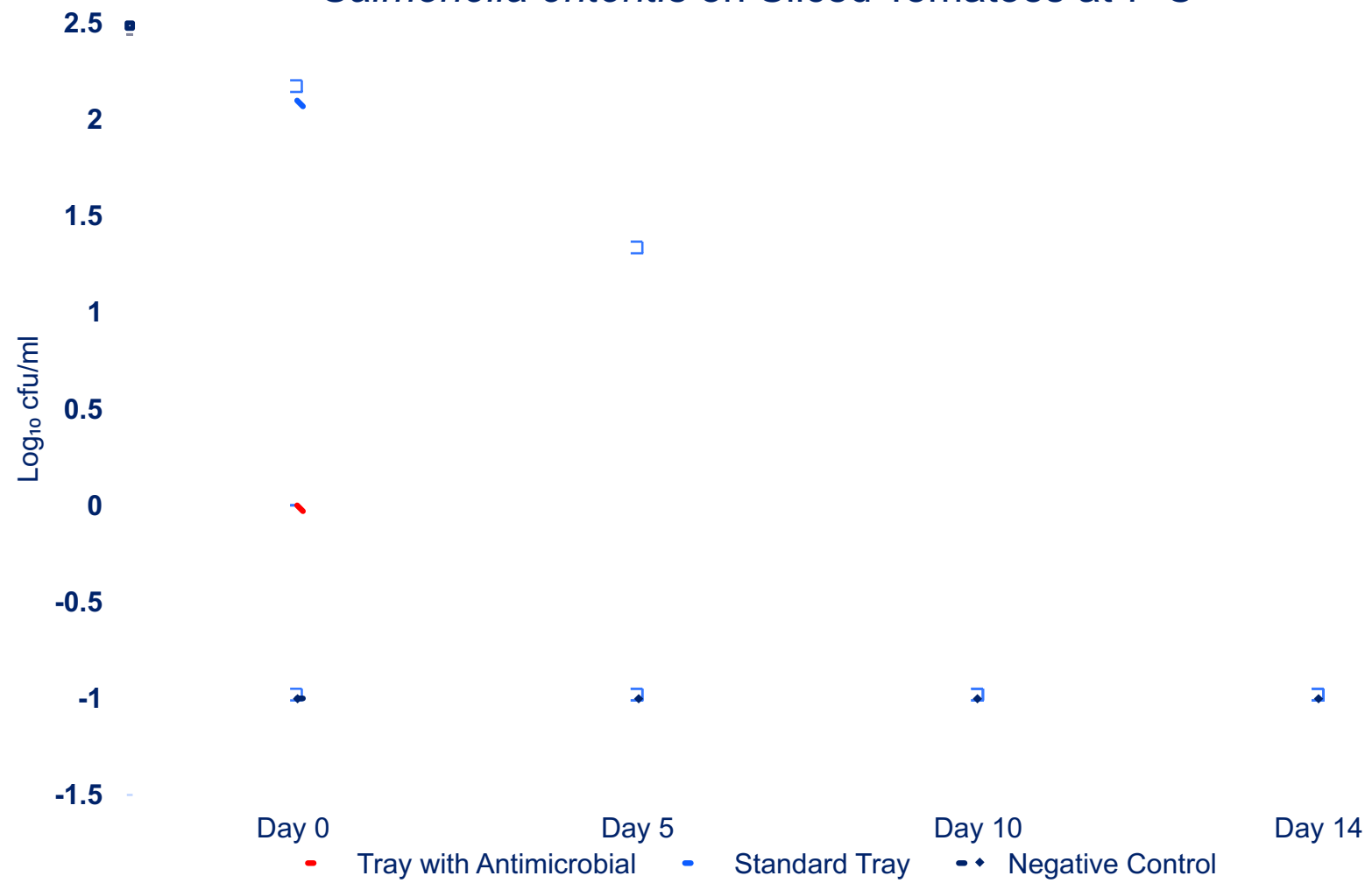


LOW INOCULATION LEVEL TESTING ~3 LOG



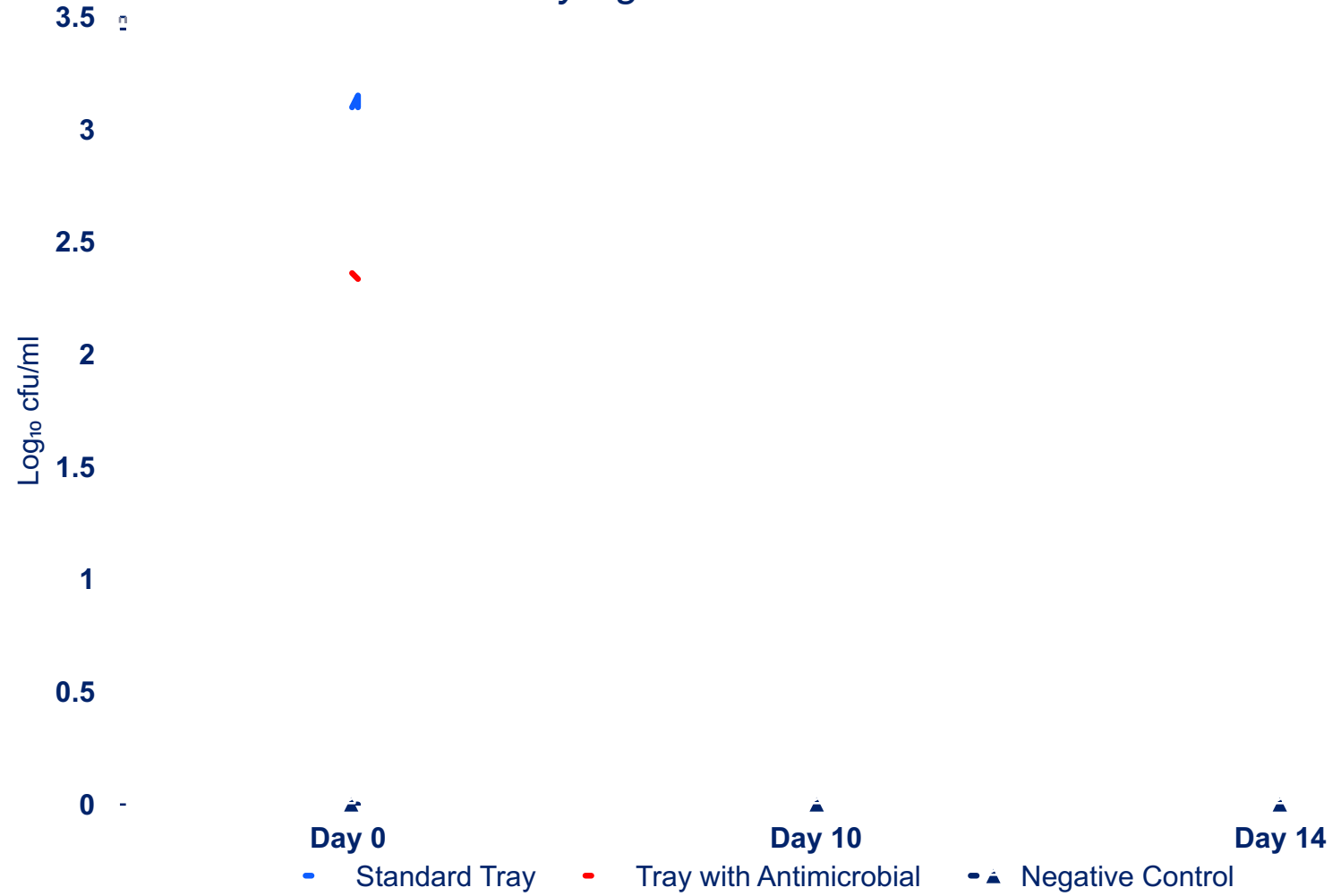


Salmonella enteritis on Sliced Tomatoes at 7°C





Listeria monocytogenes on Sliced Tomatoes at 7°C



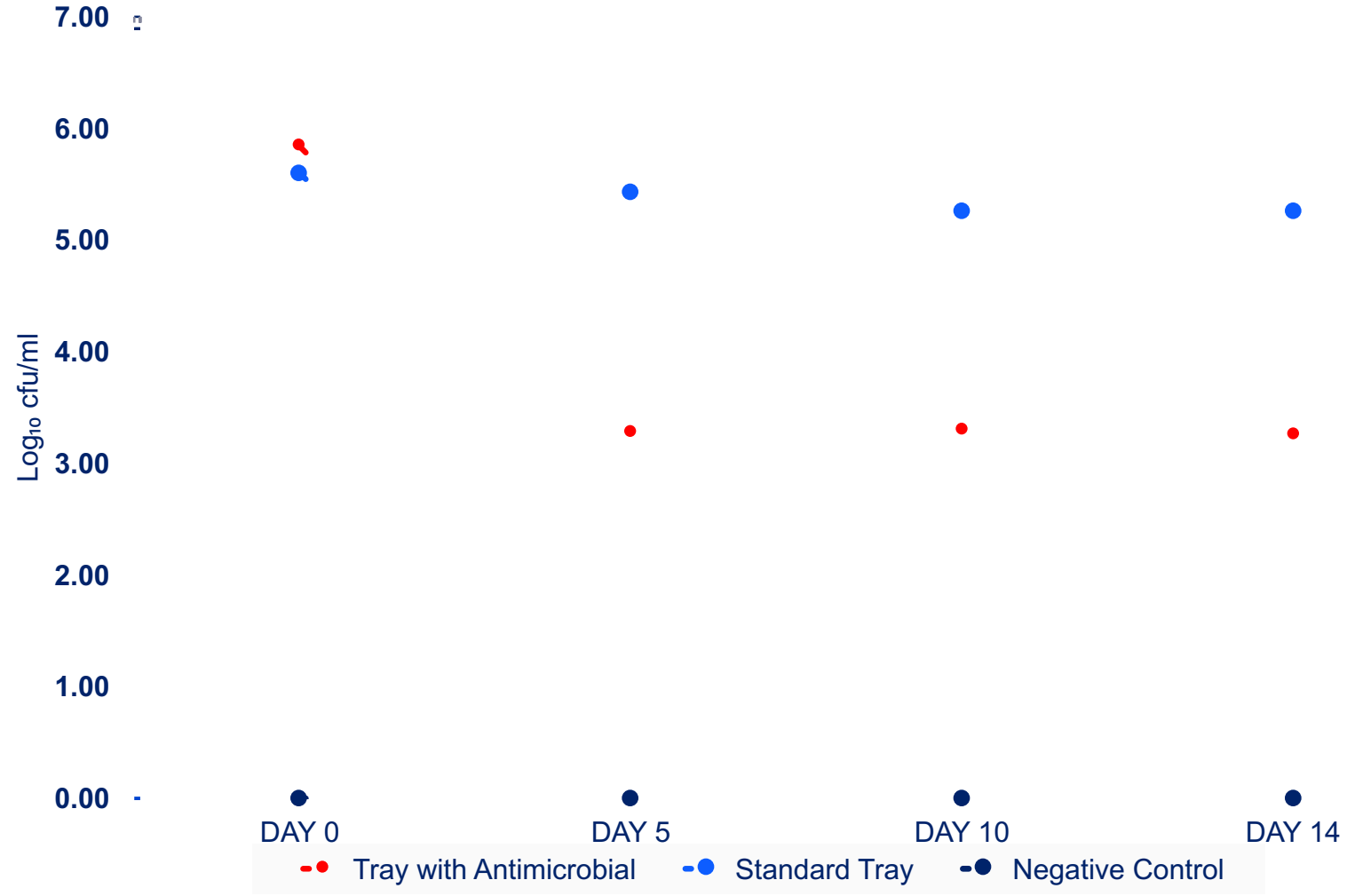


HIGH INOCULATION LEVEL TESTING ~6 LOG



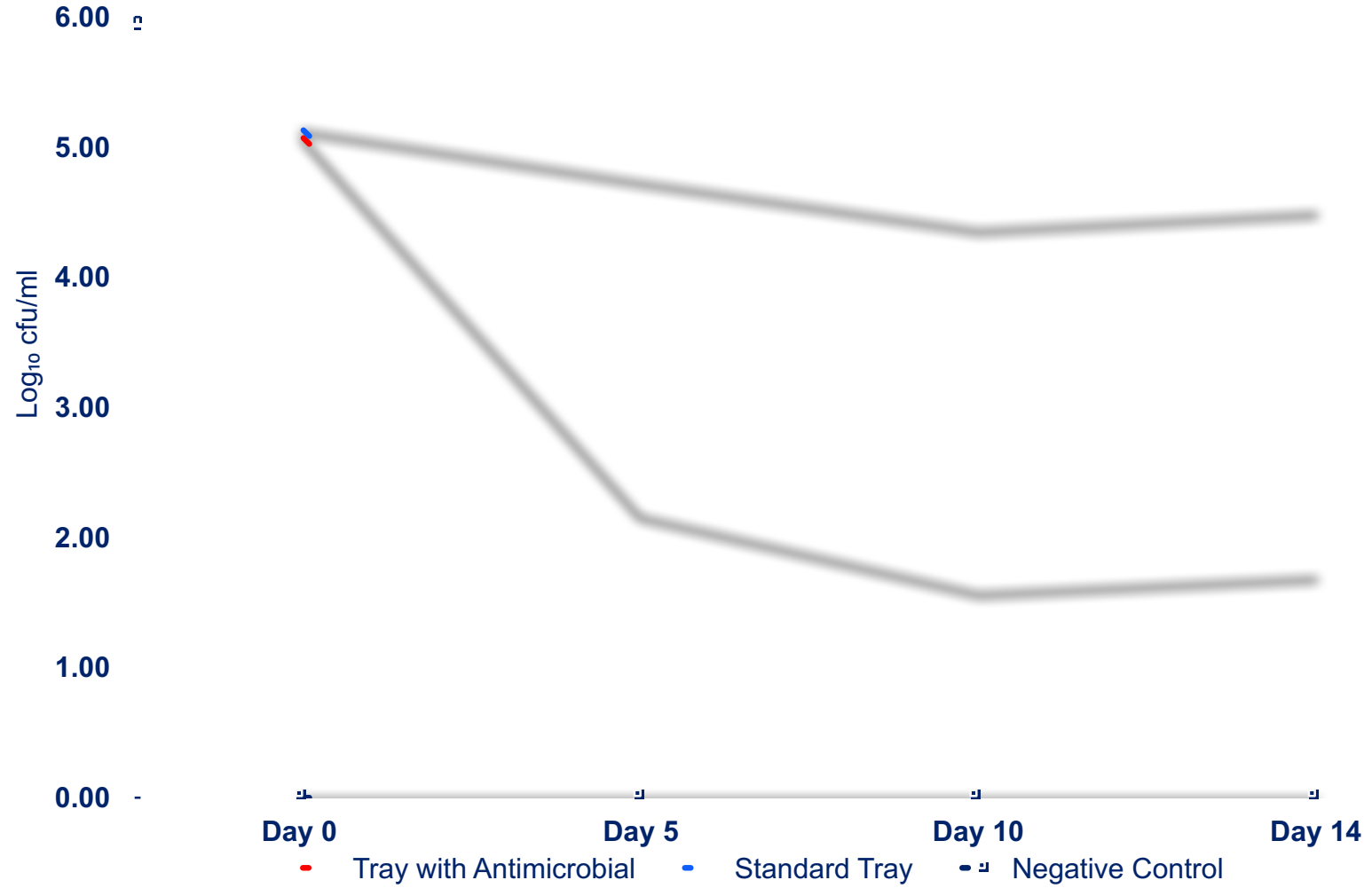


Escherichia coli O157:H7 on Sliced Tomatoes at 7°C



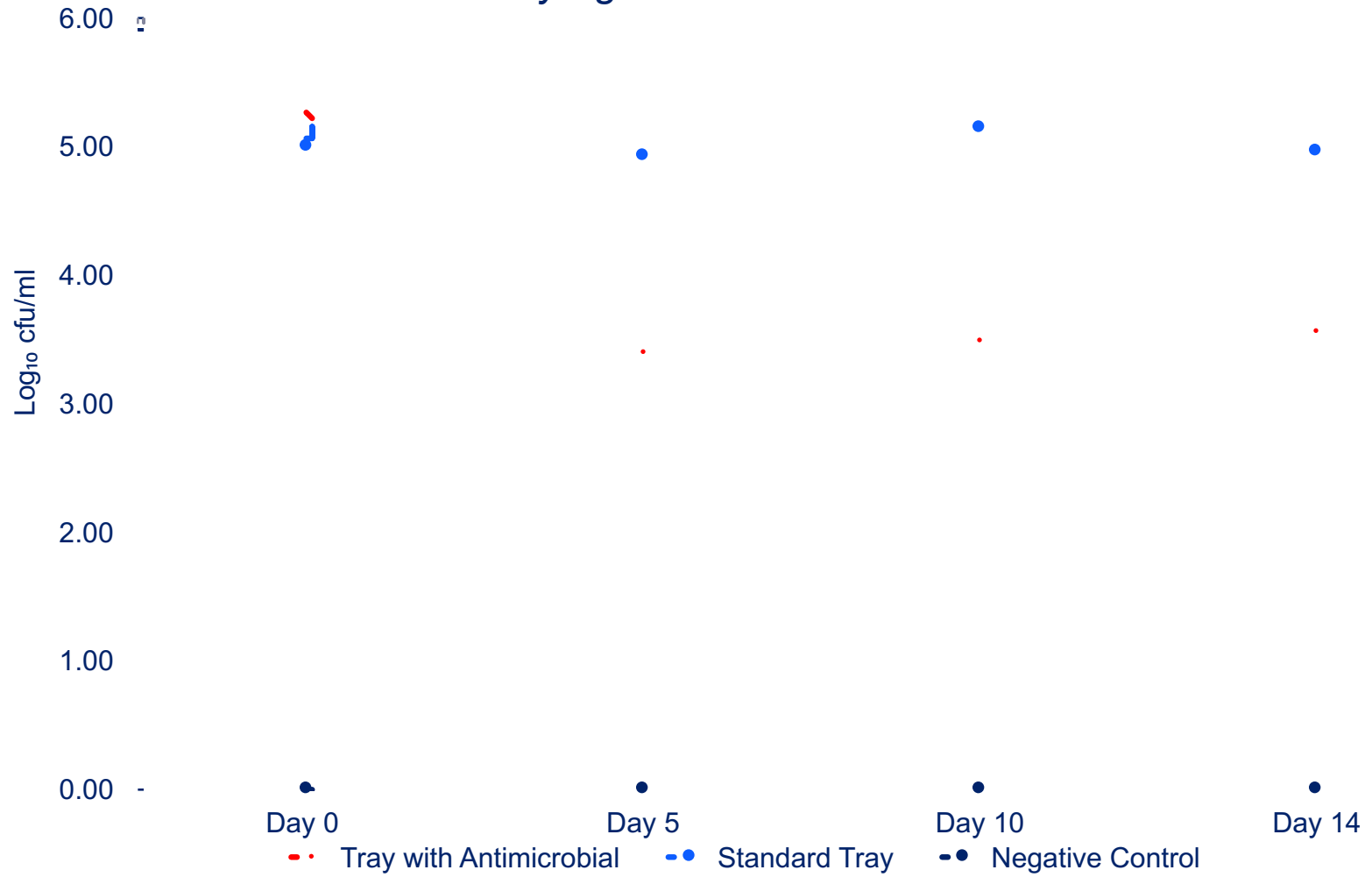


Salmonella enteritis on Sliced Tomatoes at 7°C





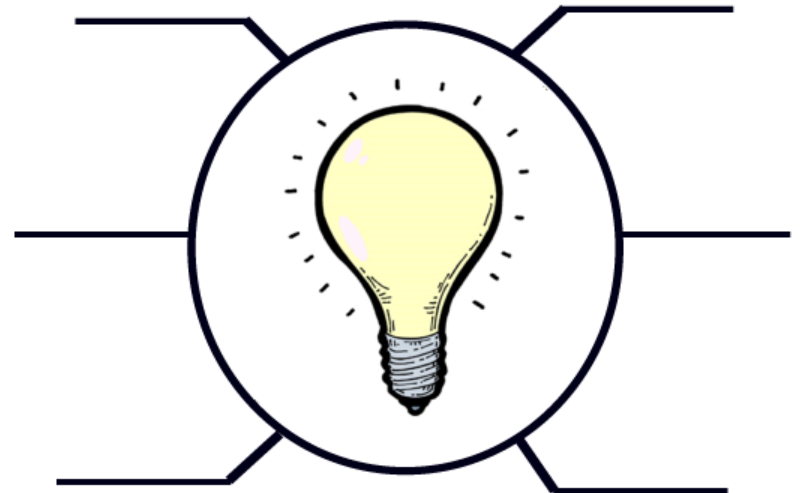
Listeria monocytogenes on Sliced Tomatoes at 7°C





CONCLUSION

The controlled release of a volatile antimicrobial into the headspace is an effective method of controlling the growth of yeast, mold, and pathogens in food packaging, extending shelf life and reducing risk to consumer health.





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QUESTIONS