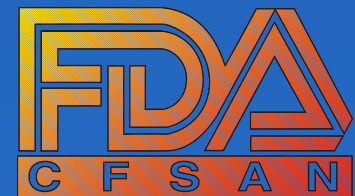


# Post-Processing Interventions to Control Listeriosis

Don L. Zink, Ph.D.

Office of Plant and Dairy Foods and Beverages  
Center for Food Safety and Applied Nutrition  
Food and Drug Administration



# Risk Management Strategies

- Eliminate *L. monocytogenes* from the environment of processing plants that produce ready-to-eat foods
- Use a pasteurization processes to destroy *L. monocytogenes*
  - In-pack pasteurization, or
  - Immediately before packaging
- Use product formulations that prevent the growth of *L. monocytogenes*

# Steam Surface Pasteurization\*

\* A joint development by ALKAR-RapidPak, Inc., Kraft/Oscar-Mayer and USDA-ERRC

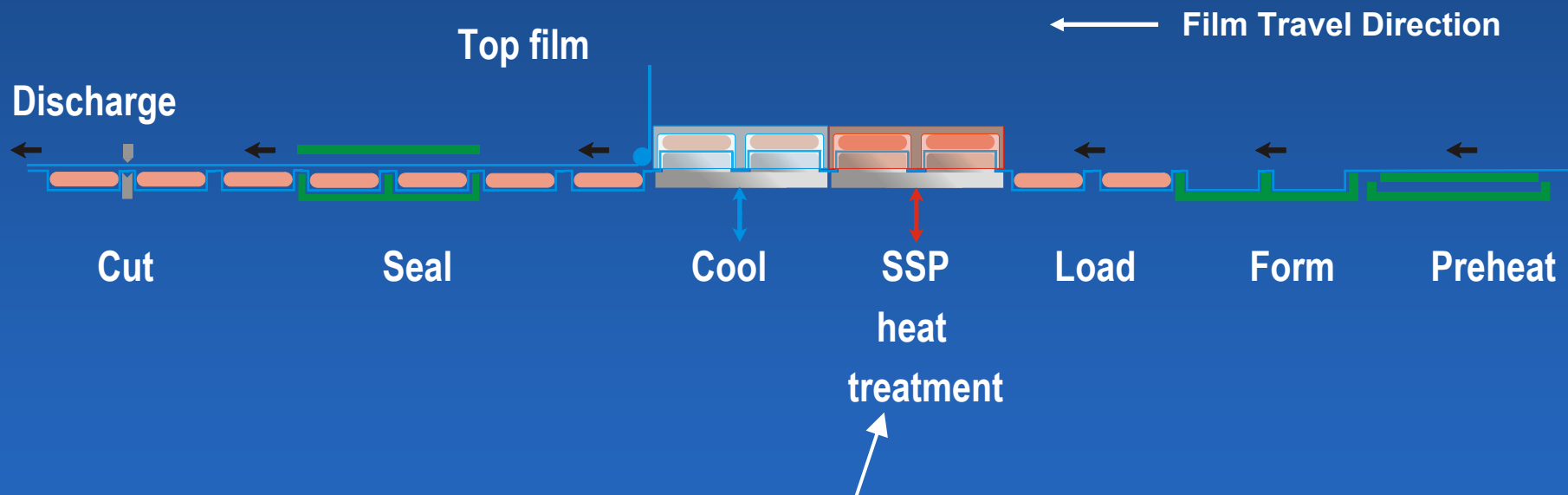


**SSP module  
extends length  
by two indexes**

- Provides a surface kill step immediately before packaging
- Adapts to existing line, no effect on line speed or packaging cost

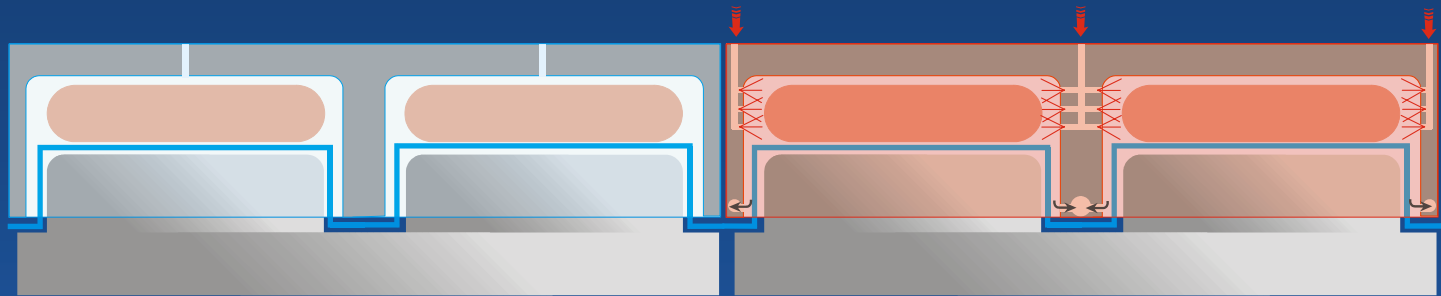
# Steam Surface Pasteurization

## Machine Configuration



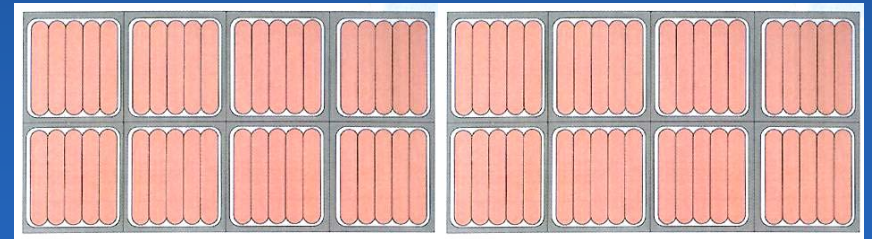
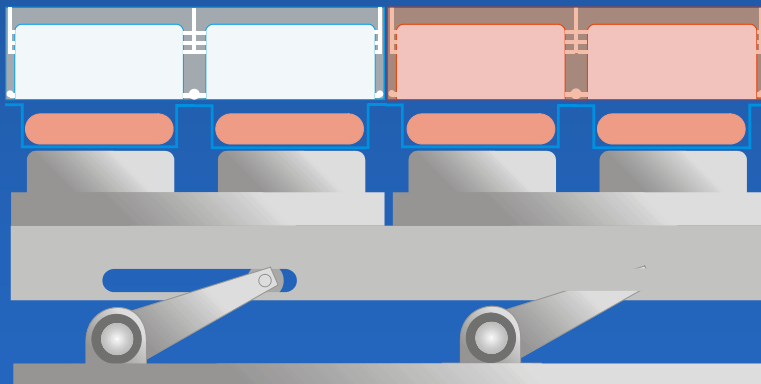
**SSP step = 1.5 sec of high pressure steam**

# Steam Surface Pasteurization



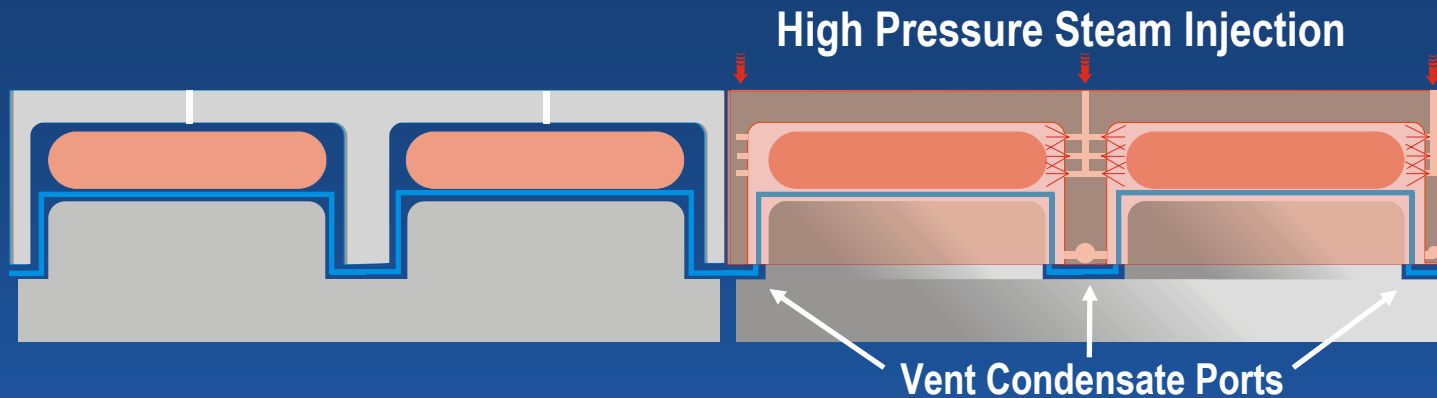
Vacuum Cooling

Steam Injection

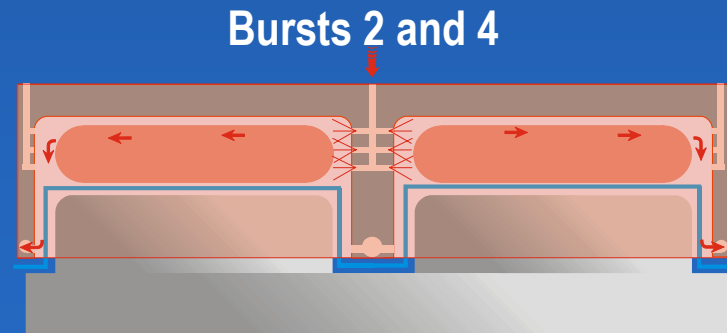
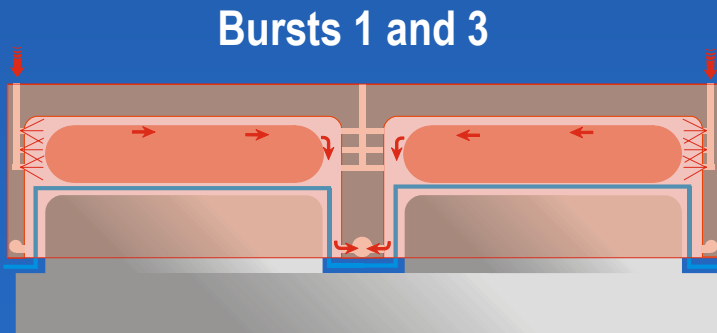


Servo lifts product pedestal up into SSP chamber

# Steam Surface Pasteurization



- Maximum contact time on most difficult area --- ends
- 1.5 second cycle time with 4 alternating steam bursts per cycle



# Steam Surface Pasteurization

- Hot dogs inoculated with indicator microorganism
- SSP treatment = 1.5 seconds
- 4-log reduction for single-layer package configuration
- Actual *Listeria monocytogenes* inoculated-pack tests ( $10^2$  per package) resulted in zero positives
- Double-layer package tests in progress
  - Preliminary findings show 2.0 - 2.5 log reduction

# High Pressure Processing



Data and images supplied by Dr. Peter Slade, NCFST

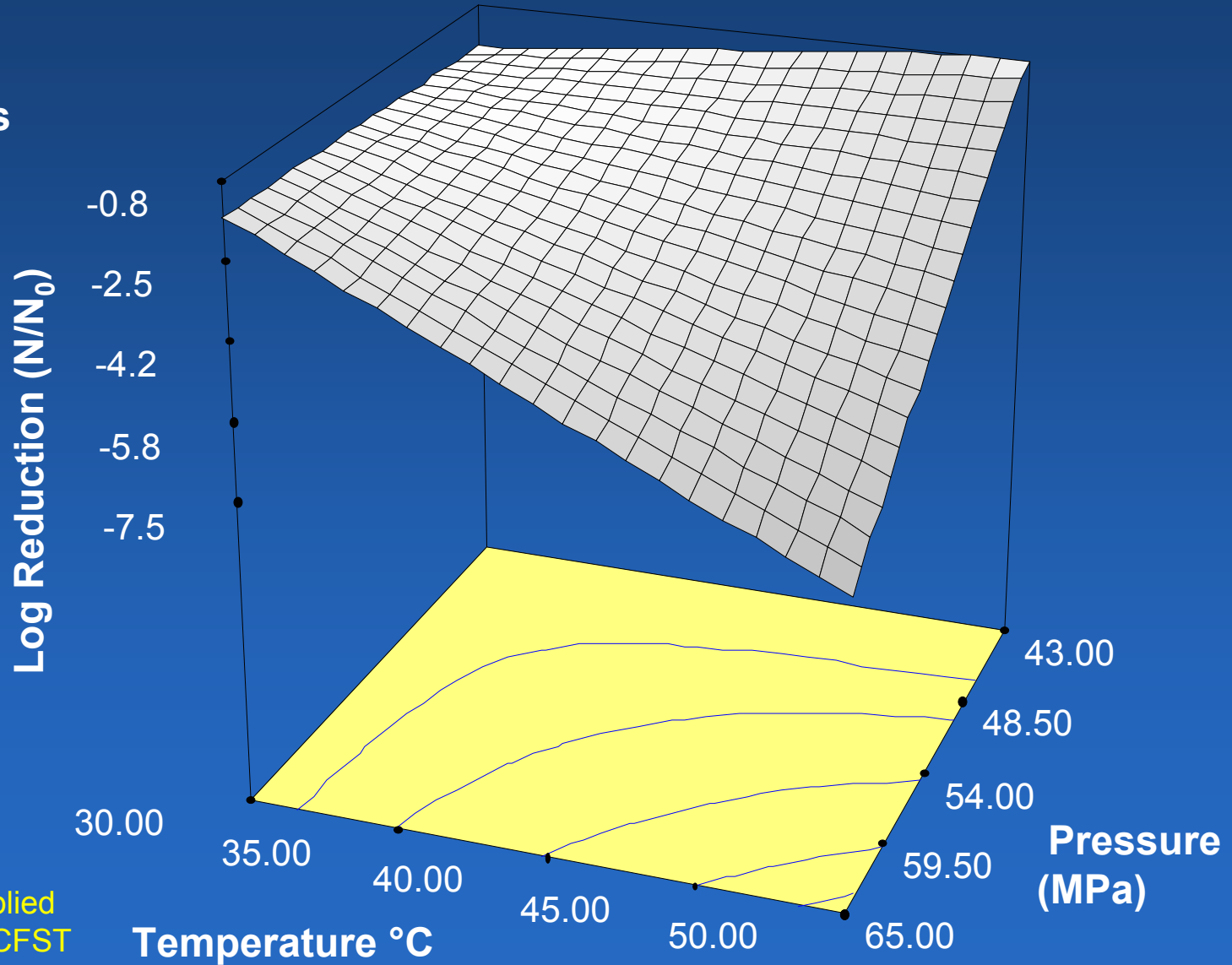


# High Pressure Processing

- Uses the combined effects of temperature and high pressure to kill bacteria
  - Minimizes thermal damage to products
  - Reduces treatment time
- Lethal effect of treatment can be modeled and characterized for each product type
- Process can be applied to packaged product
- Not limited to surface-only effects, thus is applicable to sliced products
- A Batch process with significant capital costs

# High Pressure Processing

t = 4.0 minutes



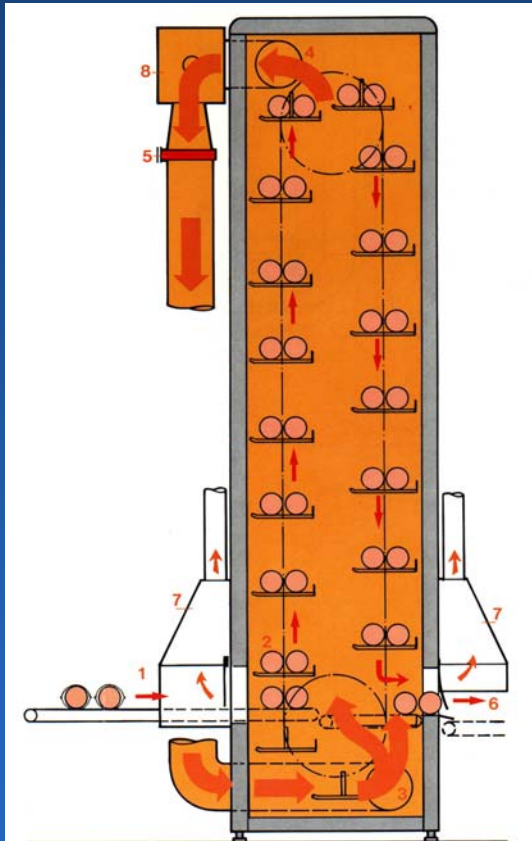
Data and images supplied  
by Dr. Peter Slade, NCFST

# High Pressure Processing

Product	Log CFU	Log N/N <sub>0</sub>
Untreated Control	8.28	0
Bologna	4.08	-4.20
Smoked Turkey	2.96	-5.32
Smoked Ham	2.88	-5.40

P = 65 Kpsig (450 MPa)      T = 40°C      t = 6.0 minutes

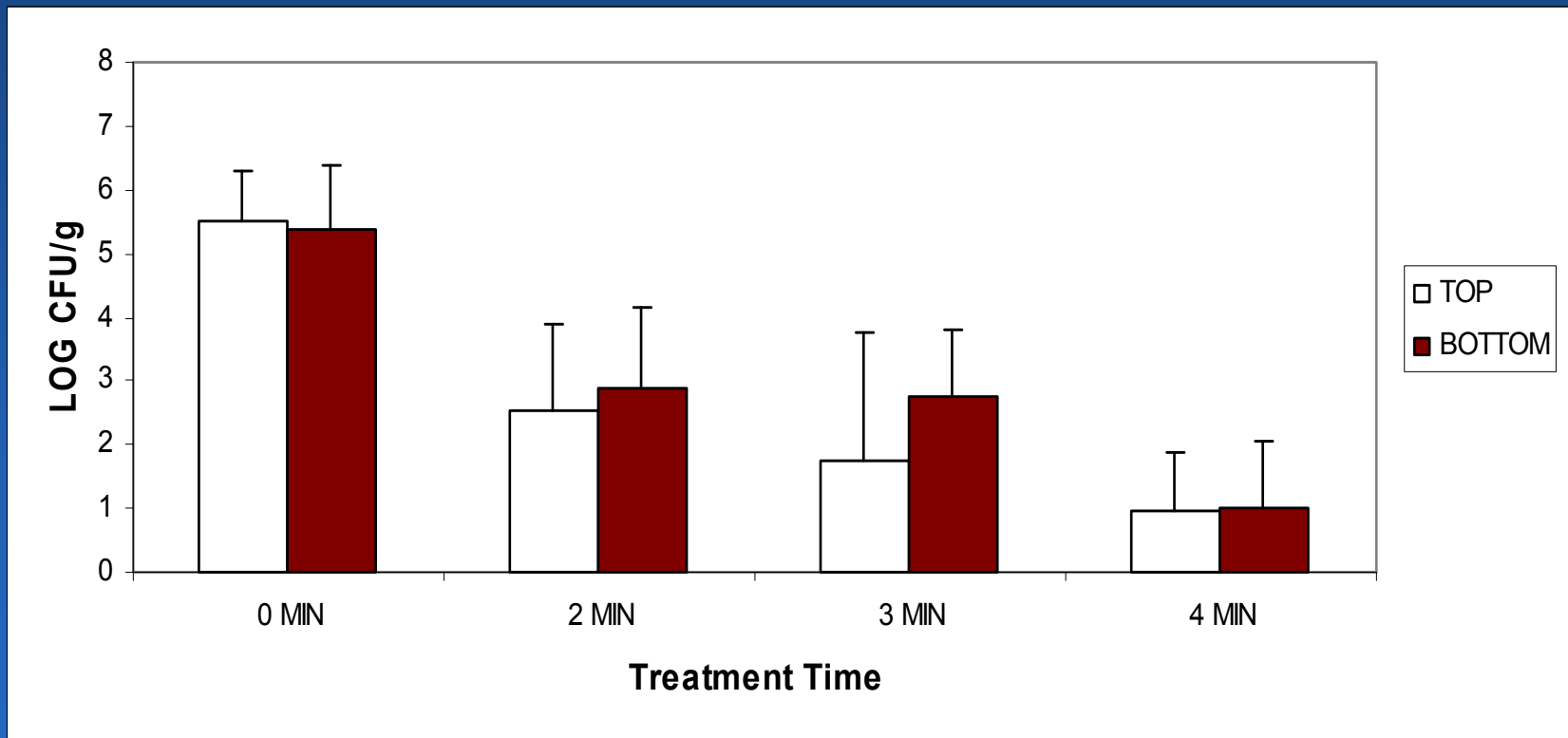
# In-Package Pasteurization



**Stork RMS-Protecon (Townsend) Steam-Based Post-Process Pasteurization System**

# In Package Pasteurization

Log cycle reduction of *Listeria monocytogenes* at 96.1°C



# Product Formulation

## Sodium or Potassium Lactate

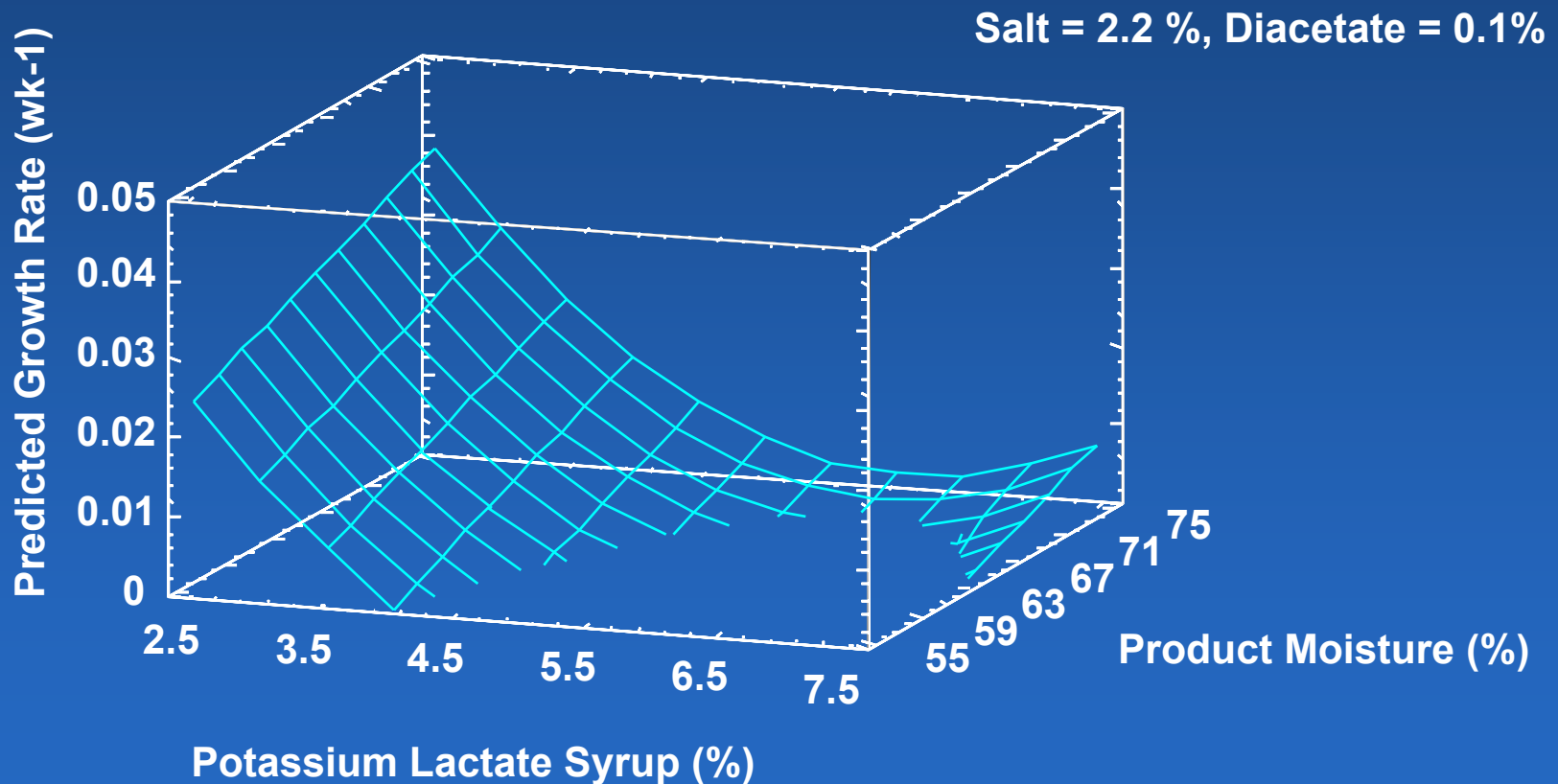
- Weak acid.
- Disrupts membrane pH gradients
- Inhibit energy metabolism.
- Lactate alone only bacteriostatic at high concentrations.

## Sodium Diacetate

- Dissociates into acetic acid and sodium acetate.
- Lowers pH due to presence of acetic acid
- Sodium diacetate alone only bacteriostatic at high levels.

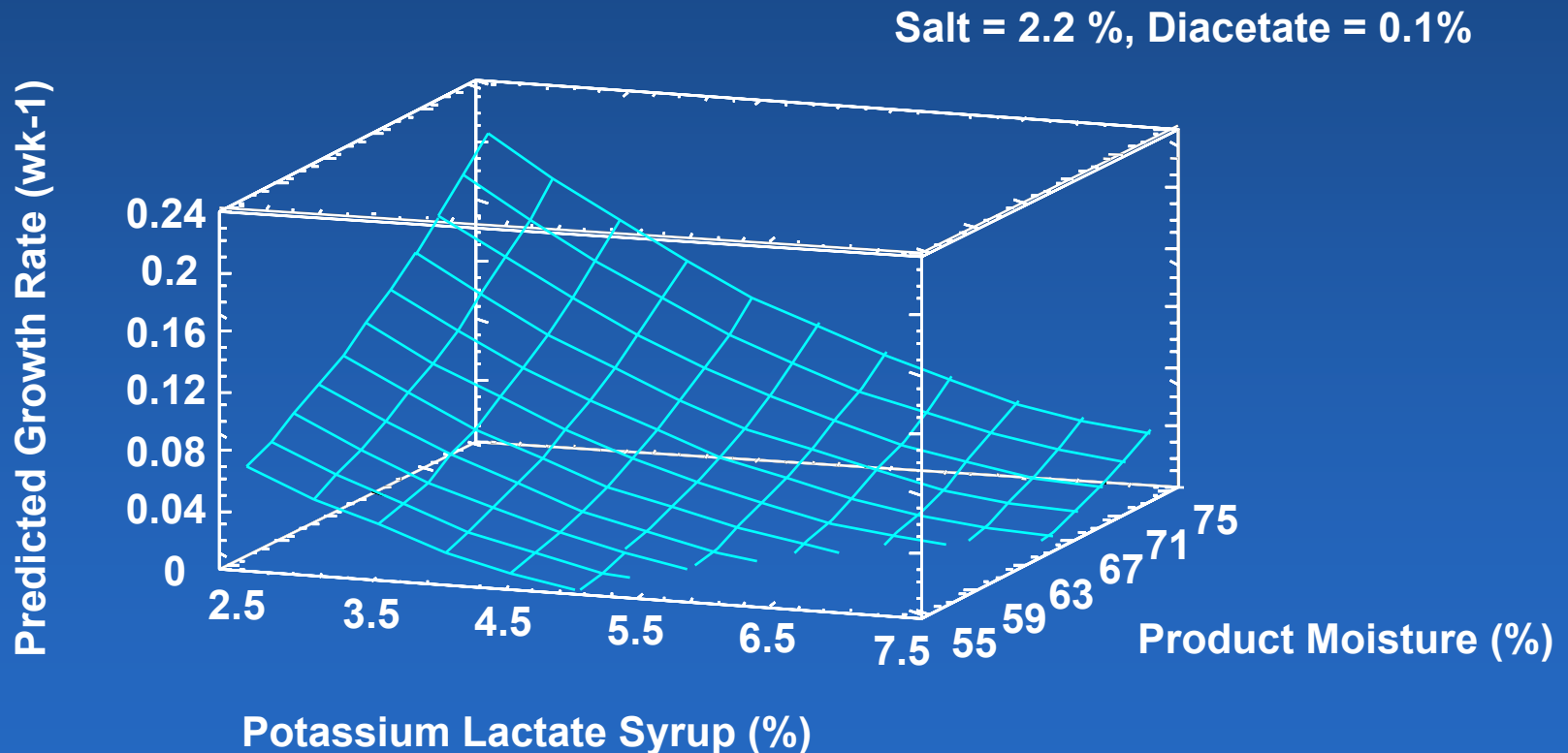
# Product Formulation

## Influence of Lactate and Moisture on Predicted Growth Rate of *L. monocytogenes* in a Cured RTE Meat



# Product Formulation

## Influence of Lactate and Moisture on Predicted Growth Rate of *L. monocytogenes* in an Uncured RTE Meat





# Product Formulation

## Application of Lactate – Diacetate to Cured RTE Meat Products

- The model has been incorporated into a spreadsheet.
- Composition (moisture, salt, lactate and diacetate) and an assumption about inoculum are input.
- Growth parameters and a predicted growth curve are generated.
- The model is used interactively to develop formulations that predict acceptable product quality and inhibit *Listeria* growth.

# Product Formulation

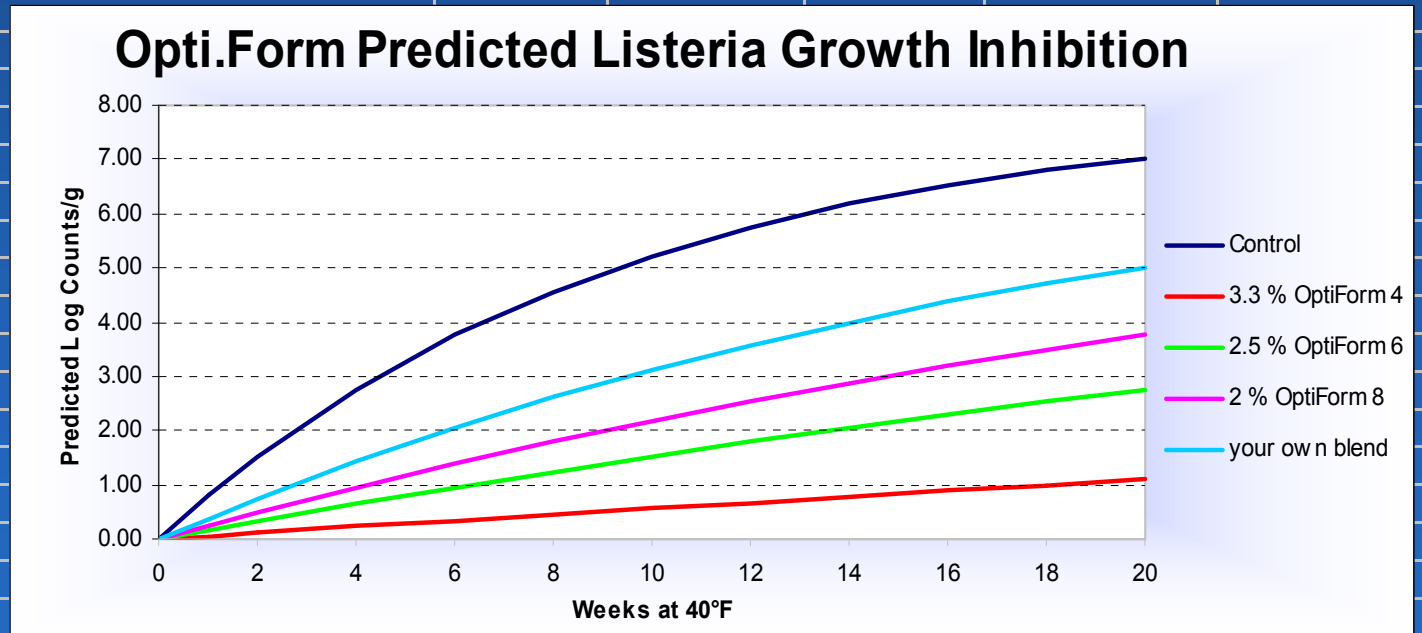
## Application of Lactate – Diacetate to Uncured RTE Meat Products

- Growth rates in uncured products are much higher
  - Nitrite inhibits the growth of *Listeria*
- Rigid environmental control programs are important for both cured and uncured products

# Product Formulation

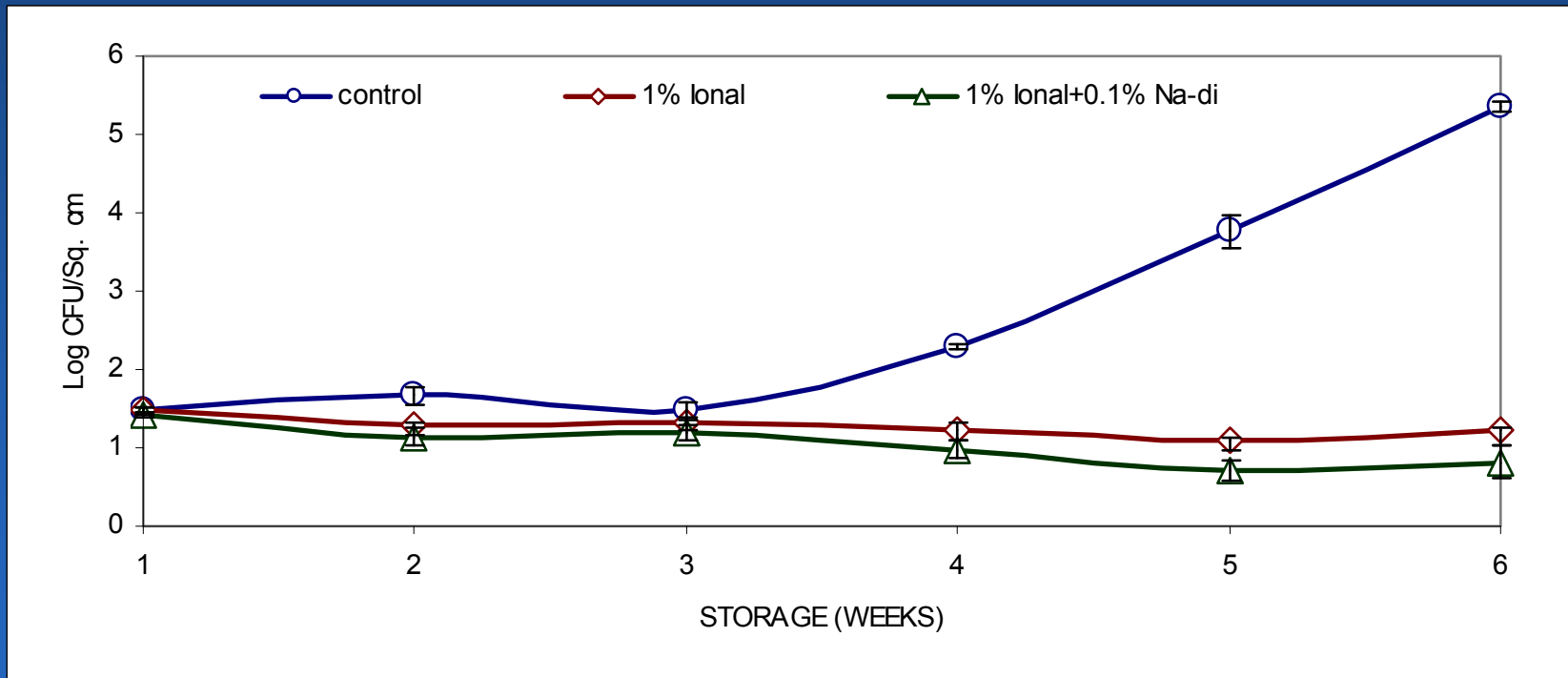
Level of use		3.3	2.5	2	
	Control	% OptiForm 4	6	% OptiForm 8	your own blend
Product Ingredients	% of Finished Product	% of Finished Product	% of Finished Product	% of Finished Product	% of Finished Product
Salt (%) =	2.50	2.50	2.50	2.50	2.50
Sodium Diacetate (%) =	0.00	0.13	0.15	0.16	0.12
Potassium Lactate (%) =	0.00	1.85	1.35	1.04	1.00
Finished Product Moisture (%) =	55.00	55.00	55.00	55.00	69.00

Calculated 60% lactate solution used in your own blend:



# Product Formulation

## Inhibition of Growth of *L. monocytogenes* at 4°C by Buffered Sodium Citrate (Ional™)



### Surface inoculum on beef franks