RUTGERS
New Jersey Agricultural
Experiment Station

Development and Application of Predictive Models for Food Microbiology

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Modeling pathogen growth out of temperature control

- August 2009, WABC-TV New York
  - Two story "exposé"
  - Risks posed by transportation of foods from wholesale cash and carry foodservice supplier
  - Schaffner is interviewed
- Jetro/RestaurantDepot contacts me
  - My first thought "oh no"
  - To develop a science-based means to assess risk and inform risk management decisions regarding transportation of cold food without temperature control

Jetro RD funded research and consulting

- Critique of the current "public health reasons" in the FDA model food code annex
- Validation of existing models
  - *Salmonella* in ground beef
- Data collection on what actually happens when selected food items are transported

Transport temperature, product geometry

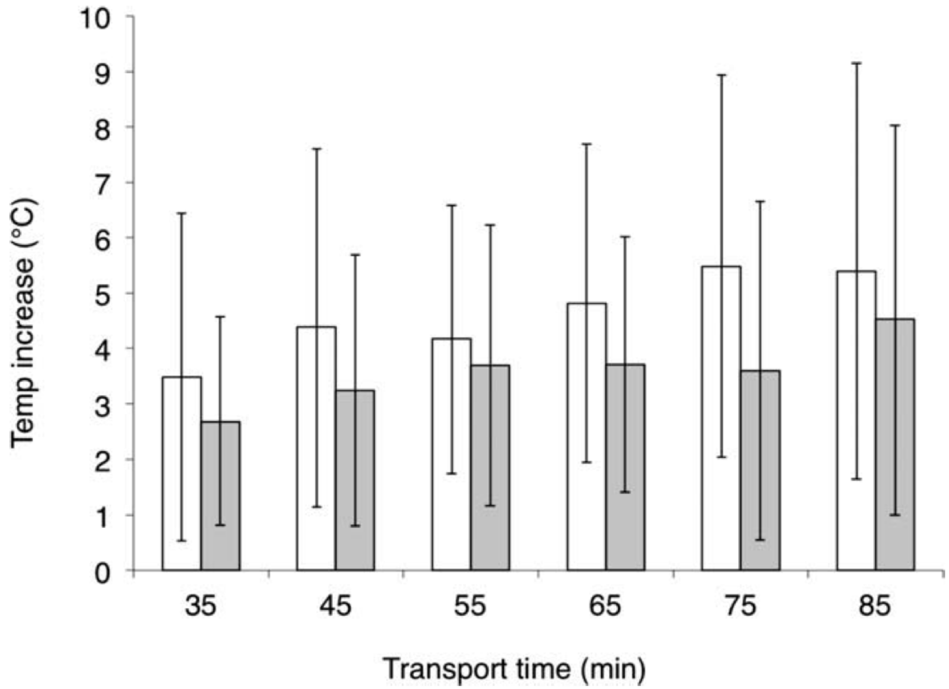


FIGURE 3. *Average temperature increase for ranges of transport times from the EcoSure database for prepackaged luncheon meat (white bars) and ground beef (gray bars). Error bars represent standard deviations around the mean.*

Assumptions

- Used ComBase models assuming no lag phase and appropriate pH and water activity
- Risk management decision about log increase
  - Less than 0.6 log CFU increase = ok
  - More than 0.6 log CFU, less than 1.0 log CFU = warning
  - More than 1.0 log CFU, danger
- Made assumptions about rate of temperature rise and fall

Modeling results – 1 log increase

Temperature on arrival (°C)	4.4	7.2	10.0	12.8	15.6	18.3	21.1	23.9	26.7	29.4	32.2	35.0	37.8
Temperature on arrival (°F)													
Time to transport (h)	**40**	**45**	**50**	**55**	**60**	**65**	**70**	**75**	**80**	**85**	**90**	**95**	**100**
0													
1											0.22	0.25	0.27
2									0.48	0.58	0.67	0.76	0.82
3								0.13	0.65	0.77	0.89	1.01	1.1
4							0.52	0.66	0.81	0.96	1.12		
5							0.63	0.79	0.97	1.15			
6						0.08	0.73	0.93	1.13				
7						0.65	0.84	1.06					
8					0.56	0.74	0.94						
9					0.62	0.82	1.05						
10					0.68	0.90							
11				0.04	0.75	0.98							
12				0.60	0.81	1.07							
13				0.65	0.87								
14				0.70	0.93								
15				0.74	1.00								
16			0.57	0.79	1.07								

Next steps and future activities

- Graduate student at Rutgers University validating *Salmonella* models in ground beef under changing temperature conditions
- Validating *Listeria* models in deli meats under changing temperature conditions
- Validating repeated temperature cycles for *Salmonella*
- Work with Conference for Food Protection committee on policy recommendations for handling foods during power outages

Validation, *Salmonella* in ground beef

Figure 3-5: 8 hours to 37°C, Cooling 8, 4, 2 hours

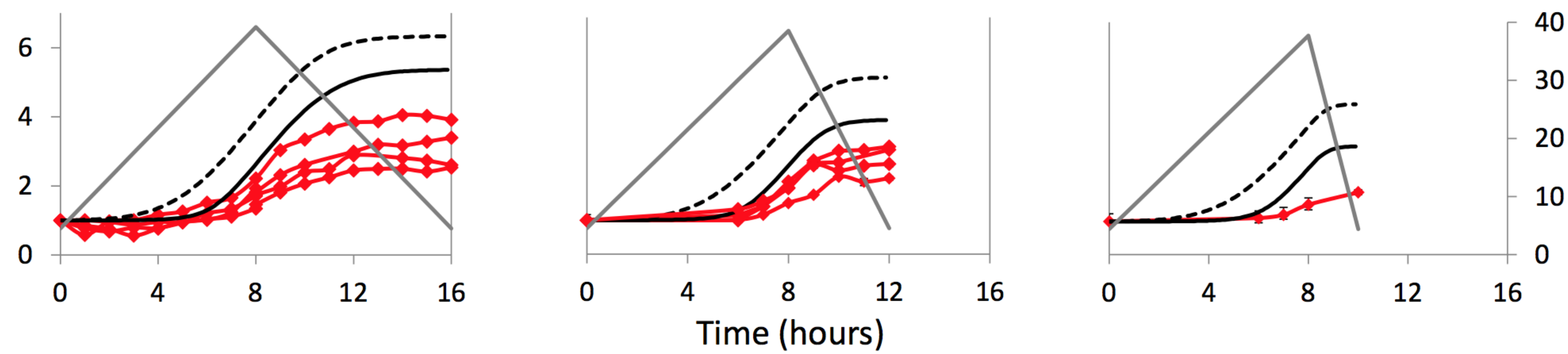
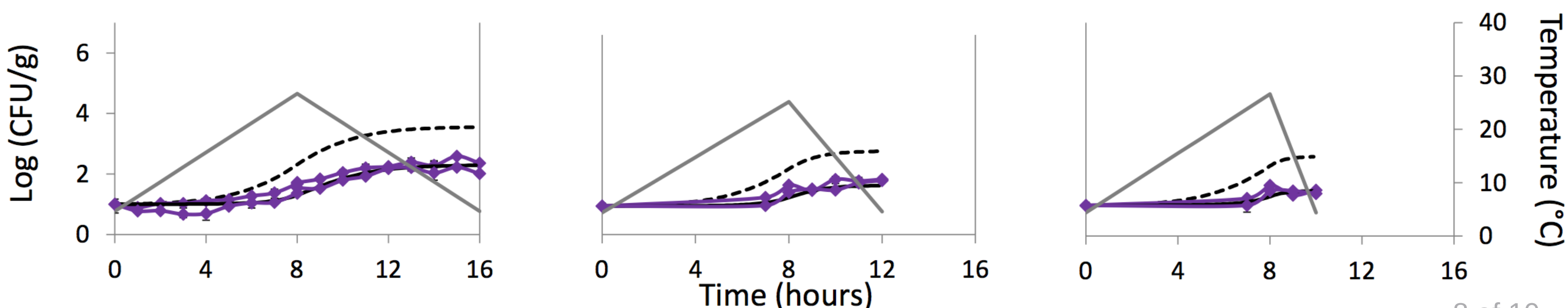


Figure 6-8: 8 hours to 27°C, Cooling 8, 4, 2 hours



Concluding messages

- Risk assessment tells you the risk
  - Risk managers must decide what to do
  - No zero risk
- Predictive models are useful
  - May be useful in developing science based regulations
- Increased recognition of value of models and risk assessments

For more information

- Schaffner, D. W. 2013. Utilization of mathematical models to manage risk of holding cold food without temperature control. J. Food. Prot. 76:1085-1094.
- McConnell, J.A and D.W. Schaffner. 2014. Validation of mathematical models for Salmonella growth in raw ground beef under dynamic temperature conditions representing loss of refrigeration. Journal of Food Protection. 77(7):1110–1115.