Cooked Product Deviations

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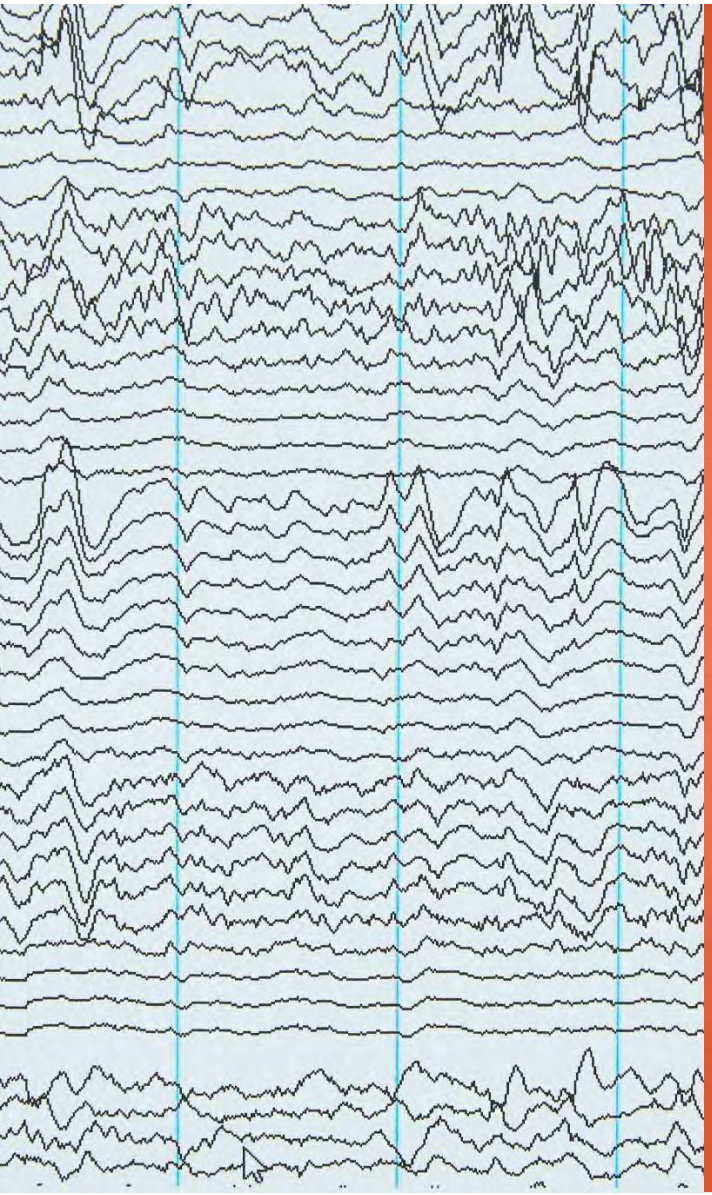
Save you money

Reduce waste

Comply with food safety requirements

- Food is the largest category of items in landfills by far
- 40 million tons or about 80 million pounds are thrown away each year
- 15.5 million pounds of meat was recalled in 2021



Critical Control Point

- Come Up Time (CUT)
- Fermentation
- Relative Humidity (RH)
- Endpoint Time/Temperature
- Cooling Time/Temperature
- Shelf Stability

Appendix A – Come Up Time – Critical Limit #1

- Total time product temperature is between 50°F and 130°F is 6 hours or less
  - Internal temperatures for non-intact products
  - Surface temperature acceptable for intact products
  - Only for products cooked to lethality (fully cooked)
- Staph. aureus and toxin

Come Up Time Deviation

- Stay between 50F and 130F for longer than six hours
- 4 options
  - Find alternate scientific support
  - Sample
  - Pathogen modeling
  - Discard

Fermentation

- Not acidification
- Degree Hours
  - Controls E. Coli and Staphylococcus aureus, also worried about Salmonella

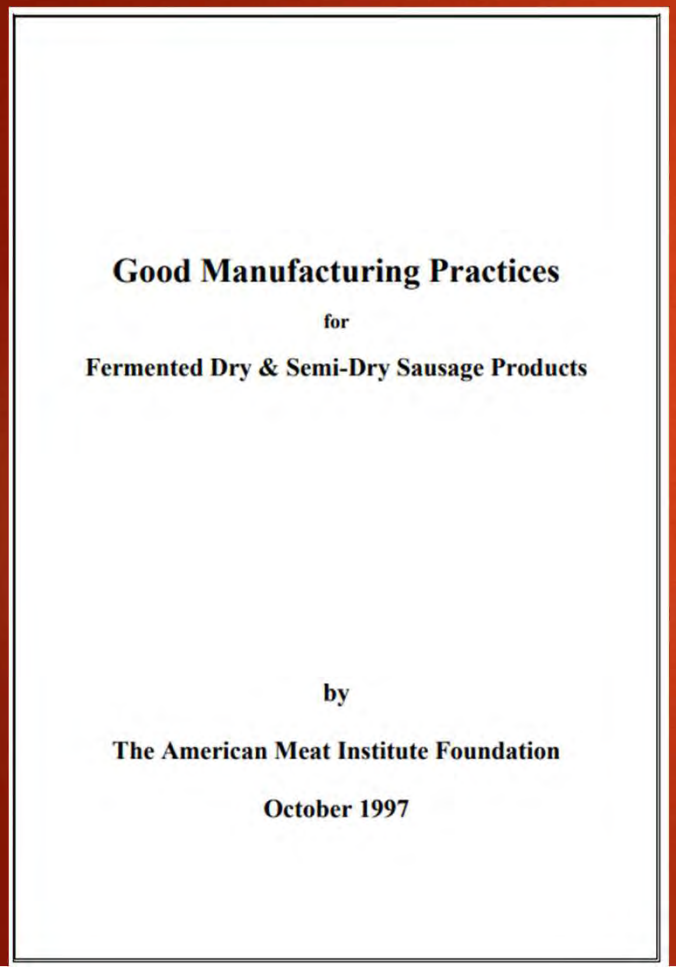
Critical Parameter 1 - Degree Hours

Time in F degree-hours above 60° F (16° C)	Maximum chamber temperature
less than 1200	less than 90° F (32° C)
< 1000	90-100° F (32-38° C)
< 900	greater than 100° F (38° C)

Constant Temperature Fermentation

	Chamber temperature		
Time in F degree-hours above 60° F (16° C)	° F	° C	Maximum hours to pH 5.3
1200	75	24	80
1200	80	27	60
1200	85	30	48
1000	90	32	33
1000	95	35	28
1000	100	38	25
900	105	41	20
900	110	44	18

Critical Parameter 1 – Degree Hour Example



Example: Fermenting a product at **80F** for **55 hours** with a **pH decline to 5.3**

1. Calculate degrees (temperature – 60)
   = 80 - 60 = 20
2. Identify hours held at temperature
   = 55
3. Multiply degrees X hours
   = (20)(55)
   = 1100 degree hours

Fermentation Deviations

- Anything above 5.3 for a prolonged period of time (18+ hours)– typically unsafe
  - Sample before product is moved to next cooking step – staphylococcus
- Temperature issues – again, worried about staph.

- Other options:
  - Find alternate support
  - Toss the product

Table 1. Critical Operating Parameters for FSIS Humidity Options

	CRITICAL OPERATING PARAMETERS		
	Relative Humidity	Endpoint Temperature	Cooking Time
OPTION 1:	The relative humidity of the oven is maintained by **continuously introducing steam** for **50 percent** of the cooking time, or 1 hour, whichever is longer.	≥145°F + dwell time	≥1 hour
OPTION 2:	The relative humidity of the oven is maintained by a **sealed oven** for at least **50 percent** of the total cooking time, or 1 hour, whichever is longer.	≥145°F + dwell time	≥1 hour
OPTION 3:	The relative humidity of the oven is maintained at **90 percent** or above for at least **25 percent** of the total cooking time, or 1 hour, whichever is longer.	**Any**	≥1 hour
OPTION 4:	The relative humidity of the oven is maintained at **90 percent** for the **entire cooking time.**	**Any**	**Any**

Appendix A – Relative Humidity – Critical Limit #2

RH –BACTERIAL HEAT TOLERANCE IS LESS OF A CONCERN WITH A HIGHER MOISTURE ENVIRONMENT

Appendix A – Humidity Options

Options with humidity deviation:

- Find alternate scientific support
- Sample product – Salmonella spp.

Appendix A – End Point Time and Temperature – Critical Limit #3 – Table 2 – Meat Products

Table 2. Time-Temperature Combinations for Meat Products to Achieve Lethality

Temperatures stated are the minimum internal temperatures that must be met in all parts of the meat product for the total dwell time listed.[5] An establishment must ensure both time and temperature parameters are met to use this table to support its process achieves the Log reduction target. **Relative humidity**[6] and heating **come-up-time (CUT)**[7] are also **critical operating parameters** when using this table. (See pages 37 and 38 for poultry endpoint time-temperature tables).

Degrees Fahrenheit	*Degrees Centigrade*	*6.5-log $_{10}$ Lethality*	*7-log $_{10}$ Lethality*
130	54.4	112 min.	121 min.
131	55.0	89 min.	97 min.
132	55.6	71 min.	77 min.
133	56.1	56 min.	62 min.
134	56.7	45 min.	47 min.
135	57.2	36 min.	37 min.
136	57.8	28 min.	32 min.
137	58.4	23 min.	24 min.
138	58.9	18 min.	19 min.
139	59.5	15 min.	15 min.
140	60.0	12 min.	12 min.
141	60.6	9 min.	10 min.
142	61.1	8 min.	8 min.
143	61.7	6 min.	6 min.
144	62.2	5 min.	5 min.
145	62.8	4 min.	4 min.
146	63.3	169 sec.	182 sec.
147	63.9	134 sec.	144 sec.
148	64.4	107 sec.	115 sec.
149	65.0	85 sec.	91 sec.
150	65.6	67 sec.	72 sec.
151	66.1	54 sec.	58 sec.
152	66.7	43 sec.	46 sec.
153	67.2	34 sec.	37 sec.
154	67.8	27 sec.	29 sec.
155	68.3	22 sec.	23 sec
156	68.9	17 sec.	19 sec.
157	69.4	14 sec.	15 sec.
158	70.0	0 sec.**	0 sec.**
159	70.6	0 sec.**	0 sec.**
160	71.1	0 sec.**	0 sec.**

[5] The required Log reductions are achieved instantly (0 seconds) when the internal temperature of a cooked meat product reaches 158°F or above.
[6] Time-Temperatures ≥ 145°F (in blue square) are eligible for FSIS Relative Humidity Options 1 and 2. All time-temperatures may apply FSIS Relative Humidity Options 3 and 4 (page 26).
[7] FSIS recommends limiting the total time product temperature is between 50 and 130°F to 6 hours or less (see page 23).

Appendix A – End Point Time and Temperature – Critical Limit #3 – Table 3 – Chicken Products

Table 3. Time-Temperature Combinations for Chicken Products to Achieve Lethality

Times for given temperatures and fat levels that are needed to obtain a 7-Log reduction of *Salmonella* in chicken products.[8] As described on page 23, **relative humidity**[9] and heating **come-up-time (CUT)**[10] are **critical operating parameters** when using this table.

Degrees Fahrenheit	Degrees Centigrade	1% fat	2% fat	3% fat	4% fat	5% fat	6% fat	7% fat	8% fat	9% fat	10% fat	11% fat	12% fat
136	57.8	63.3 min	64.5 min	65.7 min	67 min	68.4 min	69.9 min	71.4 min	73 min	74.8 min	76.7 min	78.9 min	81.4 min
137	58.3	50.1 min	51 min	52.1 min	53.2 min	54.3 min	55.5 min	56.8 min	58.2 min	59.7 min	61.4 min	63.3 min	65.5 min
138	58.9	39.7 min	40.5 min	41.3 min	42.2 min	43.2 min	44.2 min	45.3 min	46.4 min	47.7 min	49.2 min	50.9 min	52.9 min
139	59.4	31.6 min	32.2 min	32.9 min	33.6 min	34.4 min	35.2 min	36.2 min	37.2 min	38.3 min	39.6 min	41.1 min	43 min
140	60.0	25.2 min	25.7 min	26.2 min	26.8 min	27.5 min	28.2 min	29 min	29.8 min	30.8 min	32 min	33.4 min	35 min
141	60.6	20.1 min	20.5 min	21 min	21.5 min	22 min	22.6 min	23.2 min	24 min	24.9 min	25.9 min	27.1 min	28.7 min
142	61.1	16.1 min	16.4 min	16.8 min	17.2 min	17.6 min	18.1 min	18.7 min	19.4 min	20.1 min	21 min	22.1 min	23.5 min
143	61.7	13 min	13.2 min	13.5 min	13.8 min	14.2 min	14.6 min	15.1 min	15.6 min	16.3 min	17.1 min	18.1 min	19.3 min
144	62.2	10.4 min	10.6 min	10.8 min	11.1 min	11.4 min	11.8 min	12.2 min	12.6 min	13.2 min	13.9 min	14.8 min	15.9 min
145	62.8	8.4 min	8.6 min	8.7 min	8.9 min	9.2 min	9.5 min	9.8 min	10.2 min	10.7 min	11.3 min	12.1 min	13 min
146	63.3	6.8 min	6.9 min	7 min	7.2 min	7.4 min	7.6 min	7.9 min	8.2 min	8.6 min	9.1 min	9.8 min	10.6 min
147	63.9	5.5 min	5.5 min	5.6 min	5.7 min	5.9 min	6.1 min	6.3 min	6.6 min	6.9 min	7.4 min	7.9 min	8.6 min
148	64.4	4.4 min	4.4 min	4.5 min	4.5 min	4.7 min	4.8 min	5 min	5.2 min	5.5 min	5.8 min	6.3 min	6.8 min
149	65.0	3.5 min	3.5 min	3.5 min	3.6 min	3.6 min	3.8 min	3.9 min	4.1 min	4.3 min	4.6 min	4.9 min	5.4 min
150	65.6	2.7 min	2.7 min	2.7 min	2.7 min	2.8 min	2.9 min	3 min	3.1 min	3.3 min	3.5 min	3.8 min	4.2 min
151	66.1	2.1 min	2 min	2 min	2.1 min	2.1 min	2.1 min	2.2 min	2.3 min	2.5 min	2.6 min	2.9 min	3.1 min
152	66.7	1.5 min	1.5 min	1.5 min	1.6 min	1.6 min	1.6 min	1.7 min	1.7 min	1.8 min	1.9 min	2.1 min	2.3 min
153	67.2	1.2 min	1.2 min	1.2 min	1.2 min	1.3 min	1.3 min	1.3 min	1.3 min	1.4 min	1.4 min	1.4 min	1.6 min
154	67.8	55.9 sec	56.9 sec	58 sec	59.1 sec	1 min	1 min	1 min	1.1 min	1.1 min	1.1 min	1.1 min	1.1 min
155	68.3	44.2 sec	45 sec	45.9 sec	46.8 sec	47.7 sec	48.6 sec	49.5 sec	50.4 sec	51.4 sec	52.4 sec	53.4 sec	54.4 sec
156	68.9	35 sec	35.6 sec	36.3 sec	37 sec	37.7 sec	38.4 sec	39.2 sec	39.9 sec	40.7 sec	41.4 sec	42.2 sec	43 sec
157	69.4	27.7 sec	28.2 sec	28.7 sec	29.3 sec	29.8 sec	30.4 sec	31 sec	31.6 sec	32.2 sec	32.8 sec	33.4 sec	34 sec
158	70.0	21.9 sec	22.3 sec	22.7 sec	23.2 sec	23.6 sec	24 sec	24.5 sec	25 sec	25.4 sec	25.9 sec	26.4 sec	26.9 sec
159	70.6	17.3 sec	17.6 sec	18 sec	18.3 sec	18.7 sec	19 sec	19.4 sec	19.8 sec	20.1 sec	20.5 sec	20.9 sec	21.3 sec
160	71.1	13.7 sec	14 sec	14.2 sec	14.5 sec	14.8 sec	15 sec	15.3 sec	15.6 sec	15.9 sec	16.2 sec	16.5 sec	16.9 sec
161	71.7	10.8 sec	11 sec	11.2 sec	11.5 sec	11.7 sec	11.9 sec	12.1 sec	12.4 sec	12.6 sec	12.8 sec	13.1 sec	13.3 sec
162	72.2	0 sec.**	0 sec.**	0 sec.**	0 sec.**	0 sec.**	0 sec.**	9.6 sec	9.8 sec	10 sec	10.2 sec	10.3 sec	10.5 sec
163	72.8	0 sec.**	0 sec.**	0 sec.**	0 sec.**	0 sec.**	0 sec.**	0 sec.**	0 sec.**	0 sec.**	0 sec.**	0 sec.**	0 sec.**
164	73.3	0 sec.**	0 sec.**	0 sec.**	0 sec.**	0 sec.**	0 sec.**	0 sec.**	0 sec.**	0 sec.**	0 sec.**	0 sec.**	0 sec.**
165	73.9	0 sec.**	0 sec.**	0 sec.**	0 sec.**	0 sec.**	0 sec.**	0 sec.**	0 sec.**	0 sec.**	0 sec.**	0 sec.**	0 sec.**

[8] A 7-Log reduction of *Salmonella* is achieved instantly at internal temperatures in which the holding time is 0 seconds (0 sec.).

[9] Time-Temperatures ≥ 145°°F (in blue square) are eligible for FSIS Relative Humidity Options 1 and 2. All time-temperatures may apply FSIS Relative Humidity Options 3 and 4 (page 26).

[10] FSIS recommends limiting the total time product temperature is between 50 and 130°F to 6 hours or less (see page 23).

Appendix A – End Point Time and Temperature – Critical Limit #3 – Table 4 – Turkey Products

Table 4. Time-Temperature Combinations for Turkey Products to Achieve Lethality

Times for given temperatures and fat levels that are needed to obtain a 7-Log reduction of *Salmonella* in turkey products.[11] As described on page 23, **relative humidity**[12] and heating **come-up-time (CUT)**[13] are **critical operating parameters** when using this table.

Degrees Fahrenheit	Degrees Centigrade	1% fat	2% fat	3% fat	4% fat	5% fat	6% fat	7% fat	8% fat	9% fat	10% fat	11% fat	12% fat
136	57.8	64 min	64.3 min	64.6 min	64.9 min	65.3 min	65.8 min	66.3 min	66.9 min	67.6 min	68.4 min	69.5 min	70.8 min
137	58.3	51.9 min	52.2 min	52.4 min	52.8 min	53.2 min	53.6 min	54.1 min	54.7 min	55.3 min	56.2 min	57.2 min	58.5 min
138	58.9	42.2 min	42.5 min	42.7 min	43 min	43.4 min	43.8 min	44.2 min	44.8 min	45.4 min	46.2 min	47.2 min	48.5 min
139	59.4	34.4 min	34.6 min	34.9 min	35.1 min	35.4 min	35.8 min	36.2 min	36.7 min	37.3 min	38.1 min	39.1 min	40.4 min
140	60.0	28.1 min	28.3 min	28.5 min	28.7 min	29 min	29.3 min	29.7 min	30.2 min	30.8 min	31.5 min	32.5 min	33.7 min
141	60.6	23 min	23.2 min	23.3 min	23.5 min	23.8 min	24.1 min	24.4 min	24.9 min	25.5 min	26.2 min	27.1 min	28.2 min
142	61.1	18.9 min	19 min	19.1 min	19.3 min	19.5 min	19.8 min	20.1 min	20.5 min	21.1 min	21.7 min	22.6 min	23.7 min
143	61.7	15.5 min	15.6 min	15.7 min	15.9 min	16.1 min	16.3 min	16.6 min	17 min	17.4 min	18 min	18.8 min	19.8 min
144	62.2	12.8 min	12.8 min	12.9 min	13 min	13.2 min	13.4 min	13.7 min	14 min	14.4 min	15 min	15.7 min	16.6 min
145	62.8	10.5 min	10.6 min	10.6 min	10.7 min	10.8 min	11 min	11.3 min	11.5 min	11.9min	12.4 min	13 min	13.8 min
146	63.3	8.7 min	8.7 min	8.7 min	8.8 min	8.9 min	9 min	9.2 min	9.5 min	9.8 min	10.2 min	10.8 min	11.5 min
147	63.9	7.1 min	7.1 min	7.1 min	7.2 min	7.3 min	7.4 min	7.5 min	7.7 min	8 min	8.4 min	8.8 min	9.4 min
148	64.4	5.8 min	5.8 min	5.8 min	5.8 min	5.9 min	6 min	6.1 min	6.3 min	6.5 min	6.8 min	7.2 min	7.7 min
149	65.0	4.7 min	4.7 min	4.7 min	4.7 min	4.7 min	4.8 min	4.9 min	5 min	5.2 min	5.4 min	5.8 min	6.2 min
150	65.6	3.8 min	3.7 min	3.7 min	3.7 min	3.7 min	3.8 min	3.9 min	4 min	4.1 min	4.3 min	4.5 min	4.9 min
151	66.1	3 min	2.9 min	2.9 min	2.9 min	2.9 min	2.9 min	3 min	3.1 min	3.2 min	3.3 min	3.5 min	3.8 min
152	66.7	2.3 min	2.3 min	2.3 min	2.3 min	2.3 min	2.3 min	2.3 min	2.3 min	2.4 min	2.5 min	2.7 min	2.8 min
153	67.2	1.8 min	1.8 min	1.9 min	1.9 min	1.9 min	1.9 min	1.9 min	1.9 min	1.9 min	1.9 min	1.9 min	2.1 min
154	67.8	1.5 min	1.5 min	1.5 min	1.5 min	1.5 min	1.5 min	1.5 min	1.5 min	1.5 min	1.6 min	1.6 min	1.6 min
155	68.3	1.2 min	1.2 min	1.2 min	1.2 min	1.2 min	1.2 min	1.2 min	1.3 min	1.3 min	1.3 min	1.3 min	1.3 min
156	68.9	59 sec	59.3 sec	59.5 sec	59.8 sec	1 min	1 min	1 min	1 min	1 min	1 min	1 min	1 min
157	69.4	47.9 sec	48.1 sec	48.3 sec	48.5 sec	48.8 sec	49 sec	49.2 sec	49.5 sec	49.7 sec	49.9 sec	50.2 sec	50.4 sec
158	70.0	38.8 sec	39 sec	39.2 sec	39.4 sec	39.6 sec	39.8 sec	40 sec	40.1 sec	40.3 sec	40.5 sec	40.7 sec	40.9 sec
159	70.6	31.5 sec	31.7 sec	31.8 sec	32 sec	32.1 sec	32.3 sec	32.4 sec	32.6 sec	32.7 sec	32.9 sec	33 sec	33.2 sec
160	71.1	25.6 sec	25.7 sec	25.8 sec	26 sec	26.1 sec	26.2 sec	26.3 sec	26.4 sec	26.6 sec	26.7 sec	26.8 sec	26.9 sec
161	71.7	20.8 sec	20.9 sec	21 sec	21.1 sec	21.2 sec	21.3 sec	21.4 sec	21.5 sec	21.6 sec	21.7 sec	21.8 sec	21.9 sec
162	72.2	16.9 sec	16.9 sec	17 sec	17.1 sec	17.2 sec	17.3 sec	17.3 sec	17.4 sec	17.5 sec	17.6 sec	17.7 sec	17.7 sec
163	72.8	13.7 sec	13.7 sec	13.8 sec	13.9 sec	13.9 sec	14 sec	14.1 sec	14.1 sec	14.2 sec	14.3 sec	14.3 sec	14.4 sec
164	73.3	11.1 sec	11.2 sec	11.2 sec	11.3 sec	11.3 sec	11.4 sec	11.4 sec	11.5 sec	11.5 sec	11.6 sec	11.6 sec	11.7 sec
165	73.9	0 sec.**	0 sec.**	0 sec.**	0 sec.**	0 sec.**	0 sec.**	0 sec.**	0 sec.**	0 sec.**	0 sec.**	0 sec.**	0 sec.**

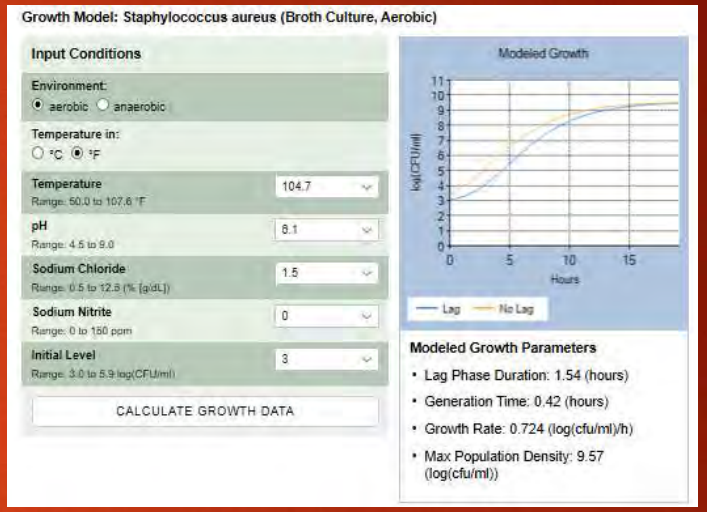
[11] A 7-Log reduction of *Salmonella* is achieved instantly at internal temperatures in which the holding time is 0 seconds (0 sec.).
[12] Time-Temperatures ≥ 145°°F (in blue square) are eligible for FSIS Relative Humidity Options 1 and 2. All time-temperatures may apply FSIS Relative Humidity Options 3 and 4 (page 26).
[13] FSIS recommends limiting the total time product temperature is between 50 and 130°F to 6 hours or less (see page 23).

Endpoint Time and Temp Deviations

- Dependent on status of batch – may be able to recook
  - Obviously cannot if it is already packaged
- If recook is not an option:
  - Look for alternate scientific support
  - Pathogen model
  - Sample

App A Deviation

- VERY specific to the cook job and what deviated
- Questions to ask:
  - What did not meet the critical limits? RH? CUT? Fermentation Degree Hours? Probe malfunction? Wrong smokehouse schedule selected?
  - Is there alternate scientific support that demonstrates product safety with this cook job?
- Typically, Staph. Aureus is what we model for, including its toxin
  - Utilize appropriate pathogen modeling program for product recipe



Appendix B – Stabilization

- Stabilization Options:
  - Cooling
  - ~~Hot Holding~~
  - Meeting and maintaining pH, salt concentration, and/or aW

Appendix B – *Clostridial* Species

- Pathogens of concern:
  - *Clostridium perfringens* – up to 1 log growth allowed
  - *Clostridium botulinum* – NO log growth allowed

Appendix B – CL's Not Required If:

- If any of the following characteristics are attained PRIOR to cooling, the cooling Critical Limits in this guideline are NOT required:
  - pH or 4.6 OR LESS, OR;
  - Brine Concentration is at 10% or more, OR;
  - Water activity is .93 or less

Table 1. FSIS Cooling Options for Products Cooked to Full Lethality[3,4,5]

Option	Critical Operating Parameters			
	Pre-Cooling Conditions	1st stage of cooling (temperature reduction/time)	2nd stage part of cooling (temperature reduction/time)	Total cooling time
Option 1.1		130 to 80°F ≤ 1.5 hours	80 to 40°F ≤ 5 hours	≤ 6.5 hours
Option 1.2	Chilling must begin within 90 minutes after the cooking cycle is complete	**120 to 80°F ≤ 1 hour**	80 to 55°F ≤ 5 hours; Continuous chilling until 40°F	≤ 6 hours Plus time to reach 40°F
Option 1.3	≥ 100 ppm sodium nitrite[6] + **≥ 250 ppm sodium ascorbate or erythorbate**	130 to 80°F ≤ 5 hours	80 to 45°F ≤ 10 hours	≤ 15 hours
Option 1.4	**≥ 40 ppm sodium nitrite[7] and ≥ 6% brine concentration OR $a_w \leq 0.92$**	**120 to 40°F ≤ 20 hours; Continuous temperature drop**	**NA**	**≤ 20 hours**
Option 1.5		**130 to 80°F ≤ 2 hours**	**80 to 40°F ≤ 5 hours**	**≤ 7 hours**
Option 1.6		**126 to 80°F ≤ 1.75 hours**	**80 to 55°F ≤ 4.75 hours; chilling until 40°°F**	**≤ 6.5 hours**
Option 1.7	**pH ≤ 6.0**	**126 to 80°F ≤ 2.25 hours**	**80 to 55°F ≤ 3.75 hours; Continuous chilling until 40°F**	**≤ 6 hours**
Option 1.8	**pH ≤ 5.8**	**126 to 80°F ≤ 2.75 hours**	**80 to 55°F ≤ 3.25 hours; Continuous chilling until 40°F**	**≤ 6 hours**

Appendix B – Cooling Table 1

Table 2. FSIS Cooling Options for Products that Do NOT Receive a Full Lethality[8,9]

Option	Critical Operating Parameters			
	Pre-Cooling Conditions	1st stage of cooling	2nd stage of cooling	Total cooling time
Option 2.1	**CUT between 50- 130°F ≤ 1 hour**	130 to 80°F ≤ 1.5 hours	80 to 40°F ≤ 5 hours	≤ 6.5 hours
Option 2.2	**CUT between 50-130°F ≤ 3 hours; and ≥ 2% salt; and ≥ 150 ppm sodium nitrite[10] and cure accelerator or natural source of ascorbate (sufficient for purpose)**	**130 to 80°F ≤ 1.5 hours**	**80 to 40°F ≤ 5 hours**	**≤ 6.5 hours**

Appendix B – Cooling Table 2

Shelf Stability Deviations

- Typically don't meet a pH of 4.6, a water activity of .92 or less (.85 for oxygen exposed products), or a combination of both

- Options
  - Potentially recook to dry product longer
  - Sample
  - Locate alternate scientific support
  - Label product as not shelf stable

Appendix B/Shelf Stability Deviation

- A little easier to model than Appendix A
- Same questions to ask:
  - What went wrong? Did the probe fail? Did a cooler go down?
  - How far off was the product from the critical limits?
  - Is there scientific support that demonstrates food safety is controlled for this instance?
- Typically, we model for Clostridium perfringens
  - use appropriate pathogen modeling for the product type/recipe

Deviation Tools

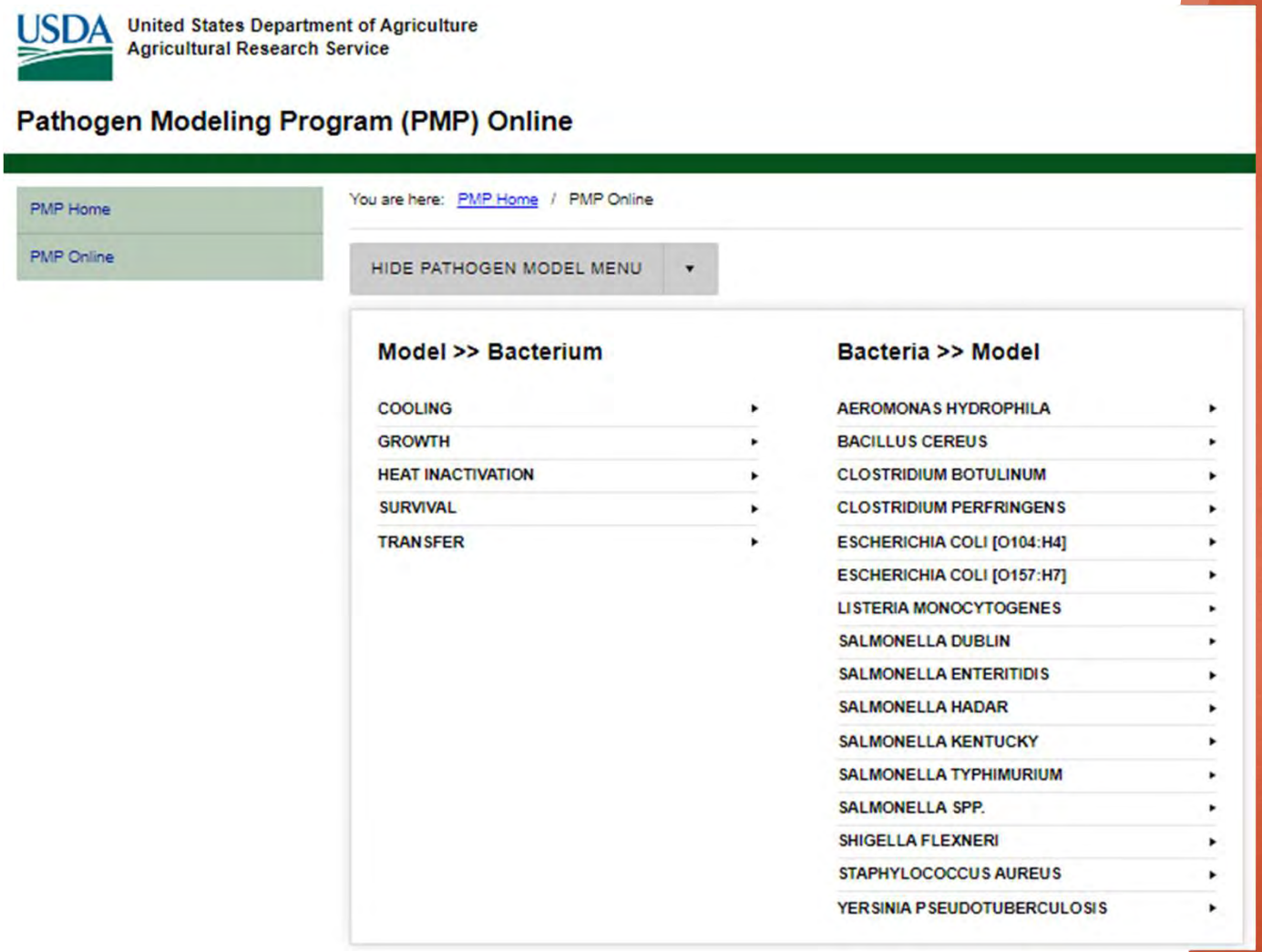
- Processing authority
  - University outreach, AAMP, Bob and Tom
- Pathogen modeling
  - ARS Pathogen Modeling Program
  - Combase
  - University of Wisconsin Therm 2.0 Predictor
  - Danish Meat Research Institute

Important

- We must have some data to support our decisions!

Addressing Different Scenarios

- If alternate scientific support matches the deviation limits, then the corrective action is just a HACCP deviation, NOT a food safety deviation
- If Pathogen Modeling identifies little or no growth of pathogens, product can be released once a corrective action is completed.
- If Pathogen Modeling identifies growth that is unclear if the product is affected, then it is wise to either test the product, rework it, or discard it
- If Pathogen Modeling identifies significant growth, discard product



ARS Pathogen Modeling Program

ARS Pathogen Modeling Program

Growth of *Clostridium perfringens* during cooling of cooked cured pork

Input Conditions

Temperature in: (•) °C ( ) °F

Initial Level (dormant) 1

Range: 0 to 6 log10 cfu/g

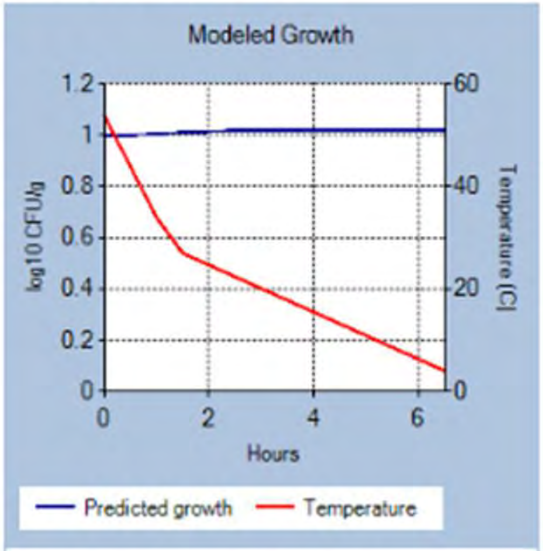
Cooling Profile (Linear Model)

```
time(hour), temperature
0, 54
0.5, 44
1.0, 34
1.5, 27
6.5, 4
```

Or import cooling profile from a file in comma-separated values (.csv) format. (See instructions after the table of results below.)

Choose File No file chosen

CALCULATE GROWTH DATA

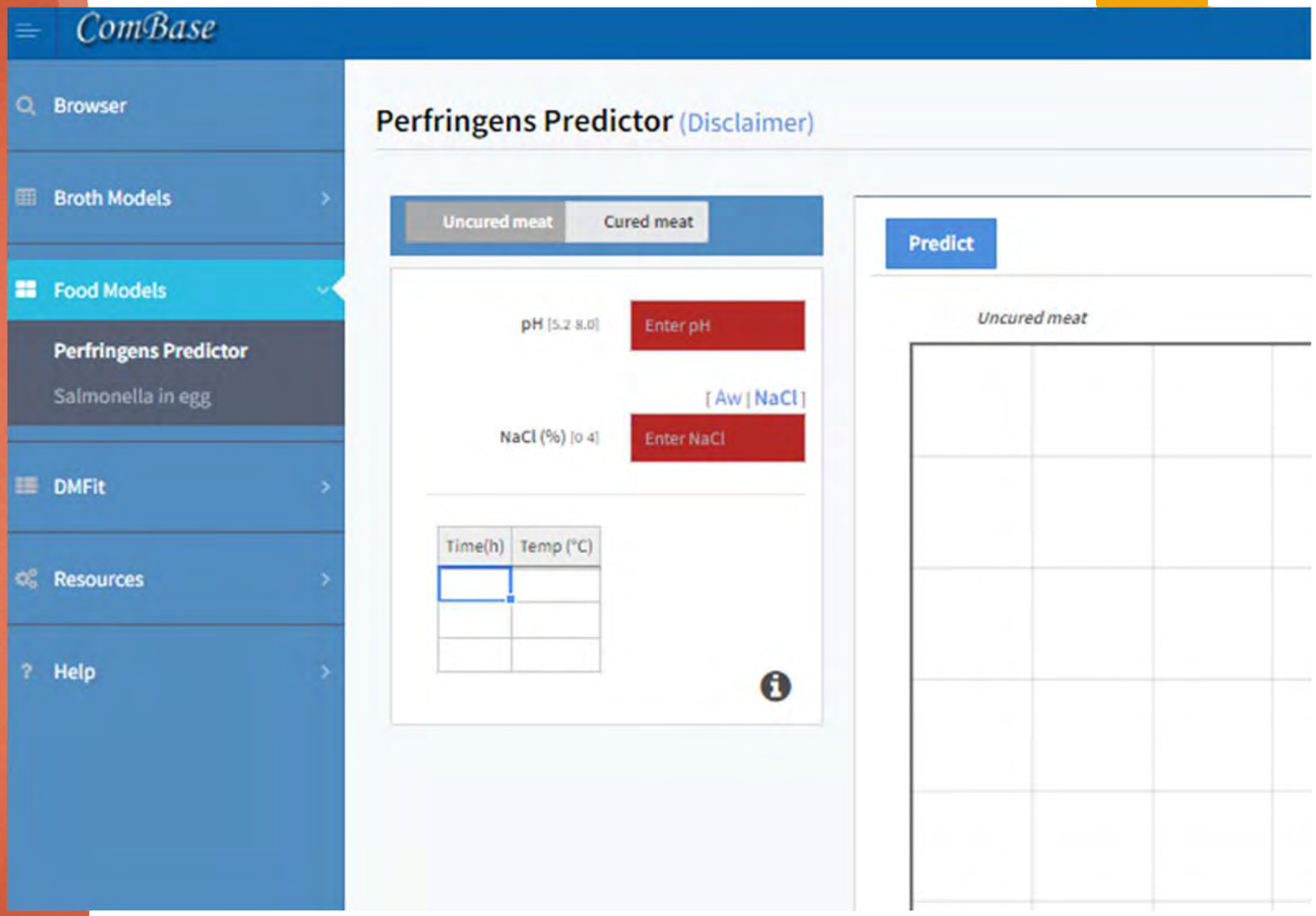


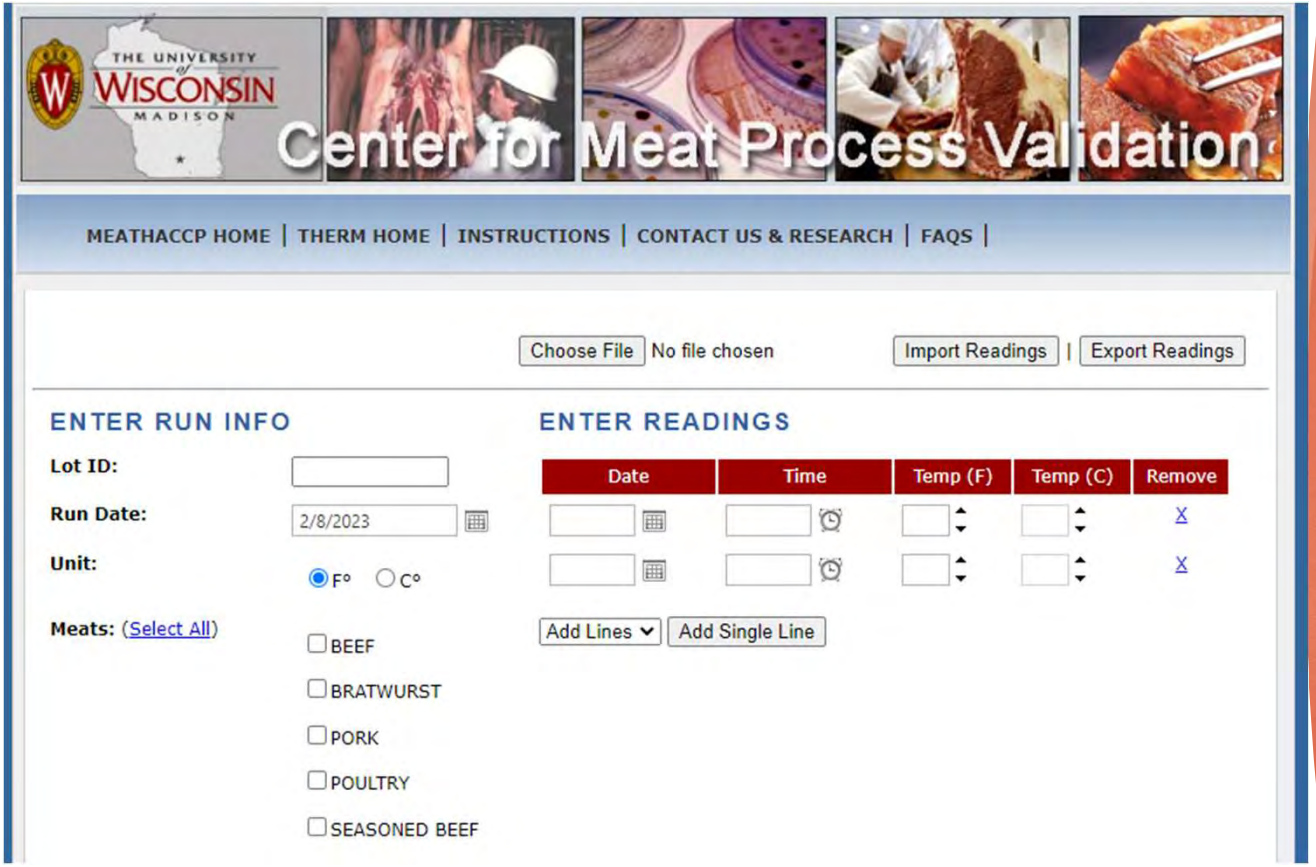
Modeled Growth Parameters

- Total Cooling Time: 6.50 (hours)
- Predicted Growth: 0.02 (log10 cfu)
- Maximum Population Density: 8.00 (log10 cfu/g)

Danish Meat Research Institute

Combase


ComBase
Browser
Broth Models
Food Models
Perfringens Predictor
Salmonella in egg
DMFit
Resources
Help
Perfringens Predictor (Disclaimer)
Uncured meat
Cured meat
pH [5.2 8.0]
Enter pH
[Aw | NaCl]
NaCl (%) [0 4]
Enter NaCl
Time(h)
Temp (°C)
Predict
Uncured meat



University of Wisconsin Therm 2.0 Predictor