



Maintenance of the cold chain during storage and transport of meat

15 June 2017

BACKGROUND

- Mandate from EC requesting a scientific opinion on the public health risks related to the maintenance of the cold chain during storage and transport of meat
- Resulted in four scientific outputs:
 - **Part 1 (meat of domestic ungulates) (03/2014)**
 - Part 2 (minced meat from all species) (07/2014)
 - Clarification on Parts 1 and 2 (10/2015)
 - Growth of spoilage bacteria during storage and transport of meat (06/2016)

EU LEGISLATION FOR TRANSPORT AND STORAGE OF MEAT

In the case of meat from animals other than poultry:

- Immediate chilling after *post-mortem* to ensure a temperature throughout the meat of not more than 3° C for offal and **7° C for other meat** along a chilling curve that ensures a continuous decrease of the temperature.
- Meat must reach the temperature specified before transport, and remain at that temperature during transport.

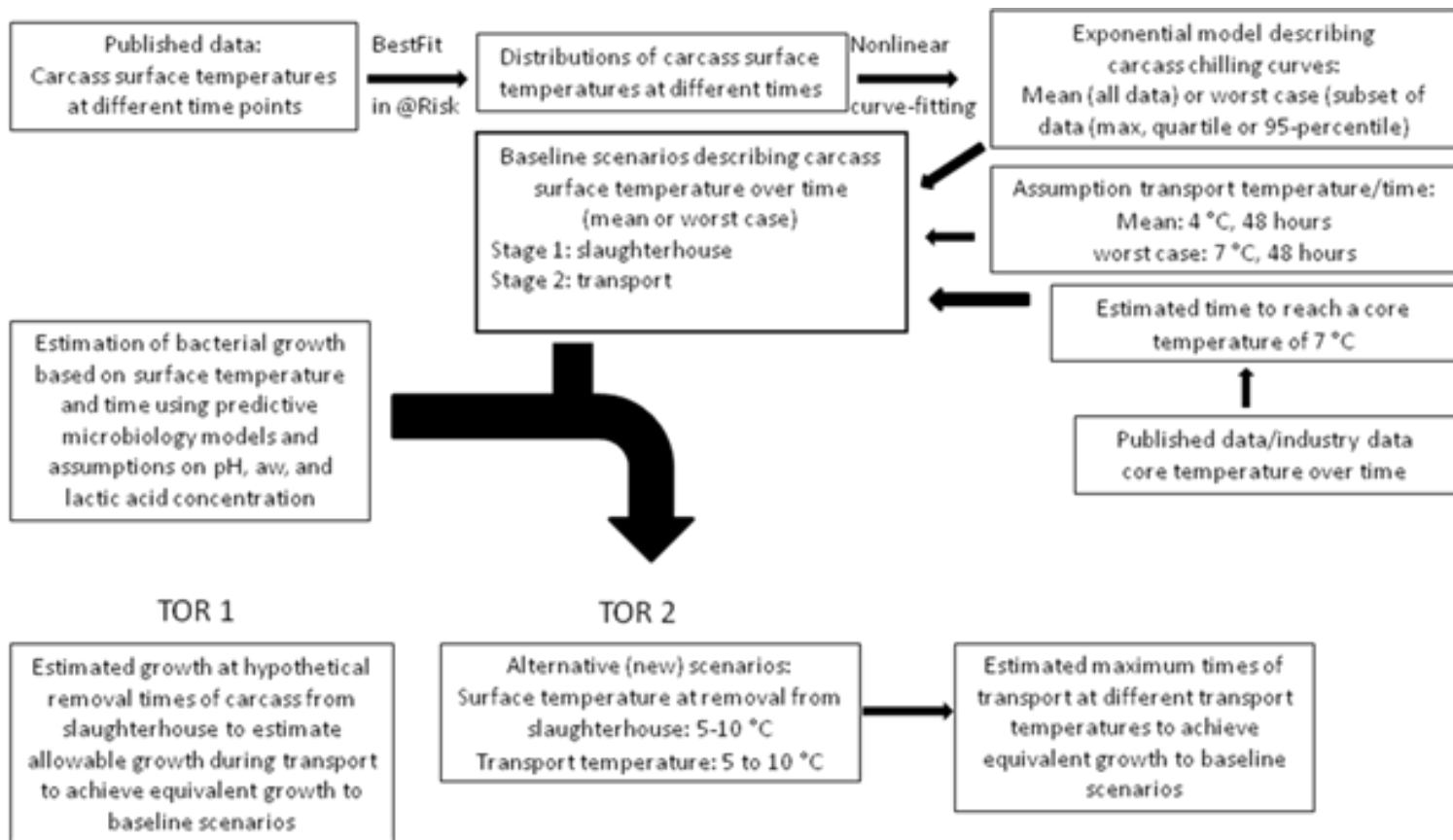
No indication of time

TERMS OF REFERENCE (PART 1) MEAT DOMESTIC UNGULATES

1. To assess if it is possible to apply **alternative core temperatures**, higher than 7 ° C, in combination with **specific transport durations** for the transport of meat (carcasses) after the slaughter, without increasing significantly the risk linked to the microbiological growth of potentially harmful microorganisms, and
2. To recommend, if appropriate, in relation to such risk, combinations of a maximum core temperature for the loading of meat (carcasses) and a maximum time for transportation.

APPROACH TO ANSWERING THE TORS

- The growth of *Salmonella* spp., VTEC, *L. monocytogenes* and *Y. enterocolitica* was predicted for **pork, beef and lamb**, using the carcass surface temperature profiles obtained when the carcasses were chilled to a core temperature of 7° C.
- Evaluate and compare different time-temperature surface chilling curves, representing **baseline and alternative chilling scenarios**, in terms of the estimated potential bacterial growth during chilling.



ComBase

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Access ComBase

The ComBase Browser enables you to search thousands of microbial growth and survival curves that have been collated in research establishments and from publications.

The ComBase Predictive Models are a collection of software tools based on ComBase data to predict the growth or inactivation of microorganisms

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A Web Resource for Quantitative and Predictive Food Microbiology

NEWS - DMFit Excel version and links to other predictive microbiology tools have been moved to another section of the website. They remain freely available to all registered users.

If you have already registered, simply [Login](#). If not, [Register](#) to gain access to all ComBase tools.

It includes:

- ✓ A systematically formatted database of quantified microbial responses to the food environment with more than 50,000 records

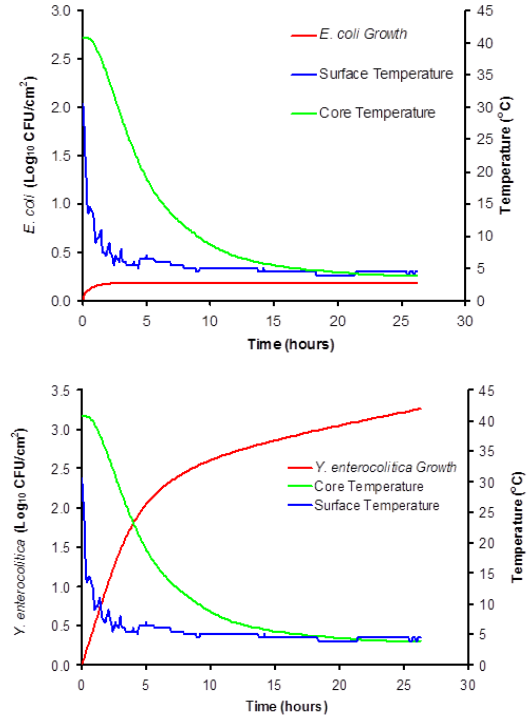
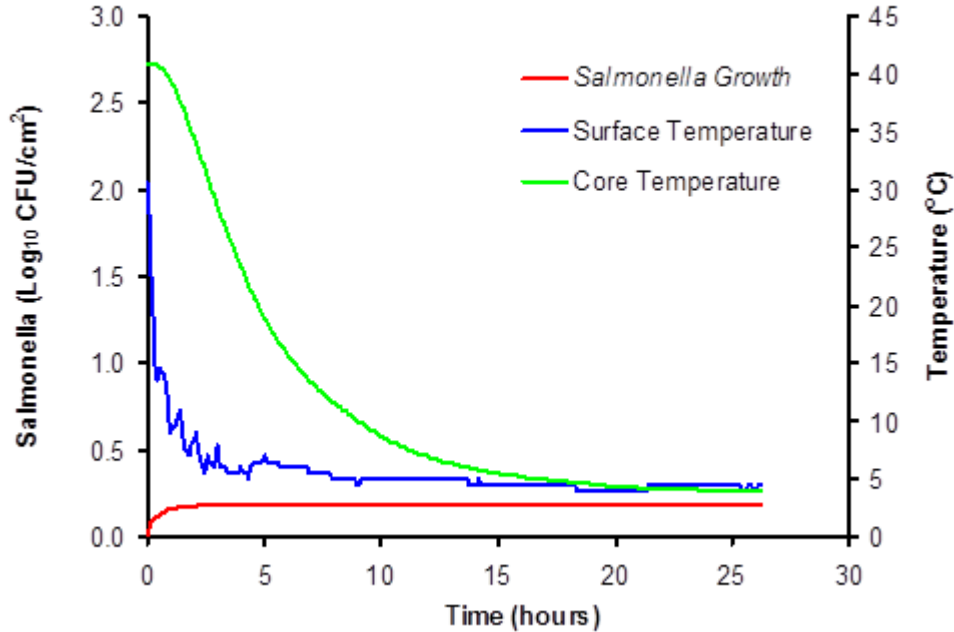
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> Event: IAFP 2017 European Symposium on Food Safety: 29-31 March 2017, Brussels, Belgium

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Predictive Microbiology
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TOR 1: RESULTS



Predicted growth of *Salmonella* spp. on pork carcasses kept in the chilling room until core temperature reaches 7 °C.

TOR 2: COMPARISON BETWEEN CURRENT AND ALTERNATIVE SCENARIOS

■ **Baseline scenarios**

- **Mean:** Chilling of carcass at the mean estimated chilling temperature profile until the core temperature reaches 7° C and subsequent transportation with a surface temperature of 4° C.
- **Worst case:** Chilling of carcass at the worst estimated chilling temperature profile until the core temperature reaches 7° C and subsequent transportation with a surface temperature of 7° C.

■ **Alternative scenarios**

- Chilling of carcass until the surface temperature reaches temperatures from 5 to 10° C and subsequent transportation with a surface temperature of 5 to 10° C.

TOR 2: RESULTS - CHILLING

Predicted growth for selected pathogens during **beef** carcass **chilling** based on the calculated **mean** temperature chilling profile. The time required for the carcass core temperature to reach 7 °C (current regulation) is compared to the time required for the surface to reach temperatures from 5 to 10 °C.

		Growth (Log₁₀ CFU/cm²)			
Chilling temperature limit		<i>Salmonella</i> spp.	<i>E. coli</i> (VTEC)	<i>L. monocytogenes</i>	<i>Y. enterocolitica</i>
Bacterial growth on the carcass when chilled to a core temperature of 7 °C (26.6 hours)		1.00	0.95	1.14	1.57
Surface T (°C)	Time in chiller (hours)				
5	9.7	1.00			1.17
6	8.5	1.00			1.13
7	7.7	1.00			1.09
8	6.8	0.98			1.04
9	6.2	0.97	0.93	0.93	1.01
10	5.6	0.95	0.91	0.89	0.96

Less growth because shorter time in chiller

TOR 2: RESULTS - TRANSPORTATION

Predicted growth of *Salmonella* spp. during carcass transportation with various surface temperature and times

<i>Salmonella</i> spp.						
Time (h)	Surface temperature (°C)					
	5	6	7	8	9	10
	Log ₁₀ CFU/cm ²					
1	0.00	0.00	0.00	0.02	0.03	0.03
2	0.00	0.00	0.02	0.04	0.05	0.07
3	0.00	0.00	0.03	0.06	0.08	0.10
6	0.00	0.00	0.08	0.12	0.16	0.20
12	0.00	0.00	0.17	0.24	0.31	0.40
24	0.00	0.00	0.36	0.49	0.63	0.81
48	0.00	0.00	0.73	0.97	1.26	1.61

<i>E. coli</i> (VTEC)						
Time (h)	Surface temperature (°C)					
	5	6	7	8	9	10
	Log ₁₀ CFU/cm ²					
1	0.00	0.00	0.01	0.01	0.02	0.03
2	0.00	0.00	0.02	0.03	0.04	0.06
3	0.00	0.00	0.02	0.04	0.07	0.10
6	0.00	0.00	0.05	0.08	0.13	0.19
12	0.00	0.00	0.09	0.17	0.27	0.39
24	0.00	0.00	0.18	0.34	0.53	0.77
48	0.00	0.00	0.37	0.67	1.06	1.54

<i>L. monocytogenes</i>						
Time (h)	Surface temperature (°C)					
	5	6	7	8	9	10
	Log ₁₀ CFU/cm ²					
1	0.02	0.03	0.03	0.04	0.05	0.05
2	0.04	0.05	0.06	0.08	0.09	0.11
3	0.06	0.08	0.09	0.11	0.14	0.16
6	0.13	0.15	0.19	0.23	0.27	0.33
12	0.25	0.31	0.38	0.46	0.55	0.65
24	0.51	0.62	0.75	0.91	1.09	1.31
48	1.01	1.24	1.51	1.82	2.19	2.61

<i>Y. enterocolitica</i>						
Time (h)	Surface temperature (°C)					
	5	6	7	8	9	10
	Log ₁₀ CFU/cm ²					
1	0.04	0.04	0.05	0.06	0.07	0.08
2	0.08	0.09	0.10	0.12	0.14	0.16
3	0.12	0.13	0.16	0.18	0.20	0.23
6	0.23	0.27	0.31	0.36	0.41	0.47
12	0.46	0.54	0.62	0.71	0.82	0.93
24	0.93	1.08	1.24	1.43	1.64	1.86
48	1.86	2.16	2.49	2.86	3.27	3.73

CONCLUSIONS

- Carcass **surface temperature** is a more relevant of chilling effect on growth than core temperature
- Carcasses could be transported before the core temperature reaches 7° C in the slaughterhouse chiller without increasing any food safety risk associated with additional growth of pathogenic bacteria **so long as the bacterial growth is controlled by efficient chilling during transportation.**

CONCLUSIONS

It is possible to calculate surface temperature - transportation time combinations that would give the equivalent amount of bacterial growth to that which would be obtained with current chilling regimes.

Examples:

- carcass chilling to a surface temperature of 5 ° C (10 h) and transportation at 5 ° C for 45 hours
- carcass chilling to a surface temperature of 8 ° C (7 h) and transportation at 7 ° C for 1 hour

QUESTIONS?

For details refer to the Scientific Opinions published on the EFSA website:

- <https://www.efsa.europa.eu/it/efsajournal/pub/3601>
- <https://www.efsa.europa.eu/it/efsajournal/pub/3783>
- <https://www.efsa.europa.eu/de/efsajournal/pub/4291>
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