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EU-RL Lm
European Union Reference Laboratory for *Listeria monocytogenes*

DESTRUCTION of LISTERIA monocytogenes IN FOODS

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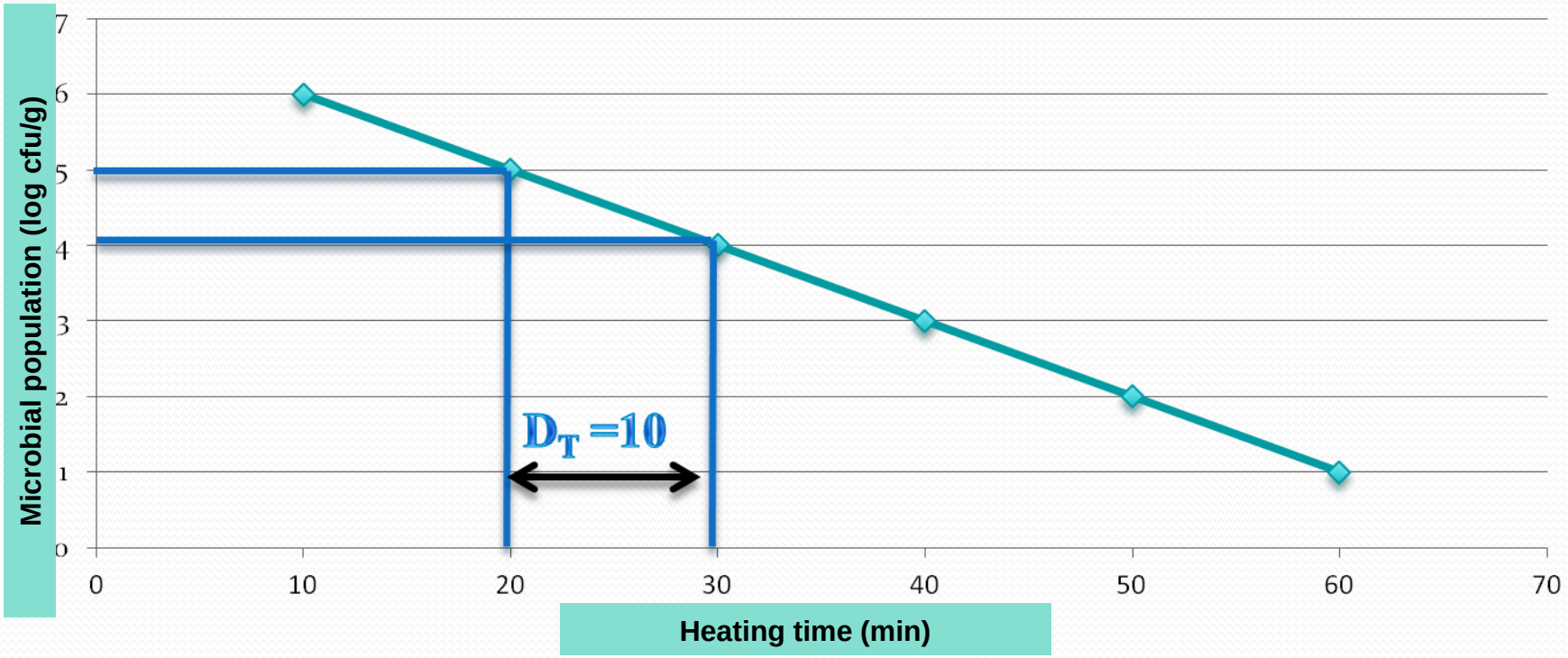
Introduction

- To enhance food safety of a product, a heating step is include in the process, to reduce the number of bacteria in a food

- To achieve this goal, the required time-temperature combinations are set, based on challenge-tests, legislation or experience

- To assess the adequacy of a heating step, the D/z - concept is often used

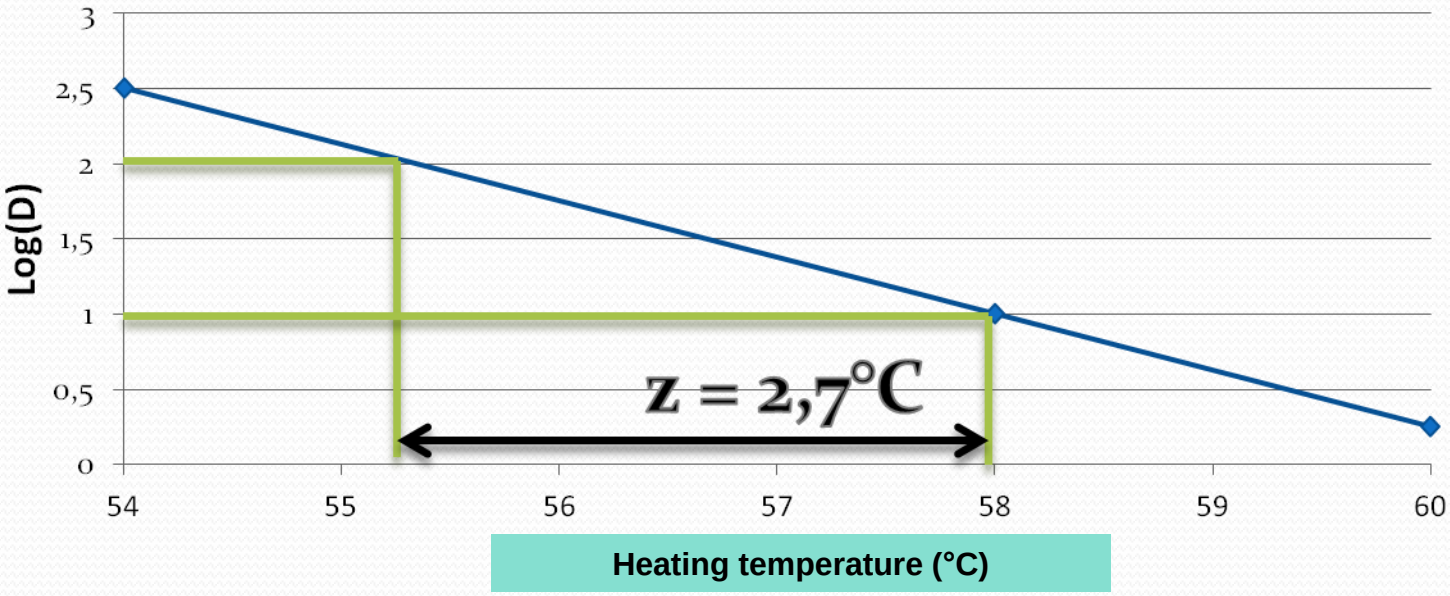
DETERMINATION of the D-value at a given temperature



- D, is the amount of heating time needed to obtain a 1-log reduction (min) at a given temperature

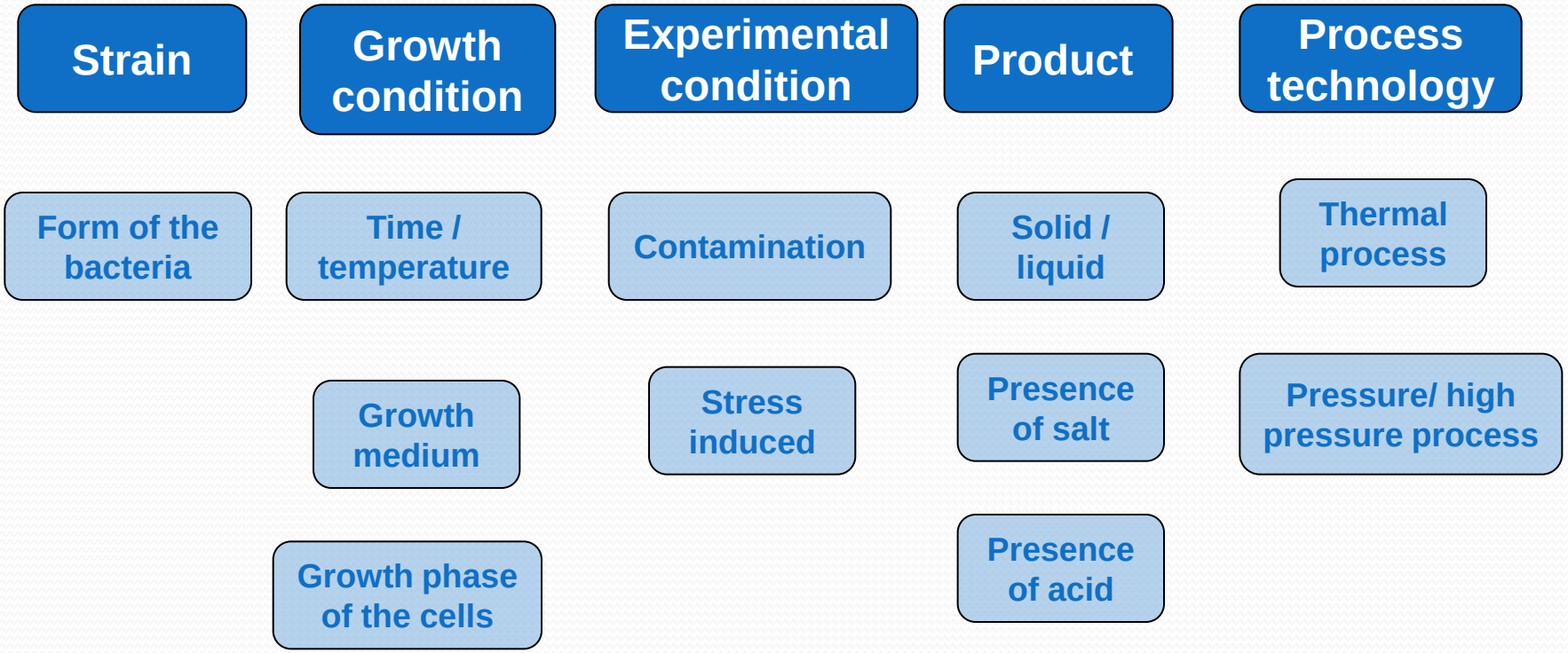
The more the bacteria resist to the heat, higher is the D-value

DETERMINATION of the z-value



- z is the temperature increase (°C) needed to reduce the D-value with a factor of 10

Factors reported to have an influence on the heat resistance of a pathogen



Resistance of *Listeria monocytogenes* to heat, in milk products (ICMSF 1996)

Products	Temp (°C)	D-value (min)
Raw milk,	52.2	24.08 - 52.8
raw skim milk	57.8	3.97 - 8.17
raw whole milk	63.3	0.22 - 0.58
cream	66.1	0.10 - 0.29

D and z values extract from litterature for different products (2000 - 2010)

	D55° (min)	D57.5° (min)	D60° (min)	D62° (min)	D65° (min)	D67.5° (min)	D70° (min)	Z (°C)
Poultry (chicken, turkey, duck)	82	40	23	7	3	0.9	0.3	6.1
				2.4	0.16			4.4
	119	40	16	4.5	1.3	0.5	0.2	5.3
	51	14	8.5	2.6	0.6	0.3	0.1	5.7
	131	23	9.8	2.2	0.93	0.4	0.1	5.0
Mean values	**95.7 ±36**	**29.2 ±13**	14.3 ±6	3.74 ±2	1.20 ±1	0.5 ±0.6	0.17 ±0.01	5.3 ±0.6
Meat (beef, pork)	37						0.06	6.0
	47						0.08	4.4
	3.4			1.17	0.6			7.7
	150	55	20	10	3.1	1.1	0.4	5.9
Sausage	5.0		1.6		1.2			
	14		2.2		0.2			
Ham			1.8					5 - 6.7

- Difficult to choose the appropriate D-value from these lists of reported values

- Difficult to know which factors may influence the heat resistance (the effect reported of a factor is usually tested in one lab for a few conditions and a few strains)

- Unclear if such effects are relevant overall in comparison with other conditions

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A systematic approach to determine global thermal inactivation parameters for various food pathogens

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- This study have collected a large quantity of D-values (n=4 066) among them *L. monocytogenes* (n= 967)

- From theses values, linear regression was applied to obtain average D-values and the 95% upper prediction level and z values

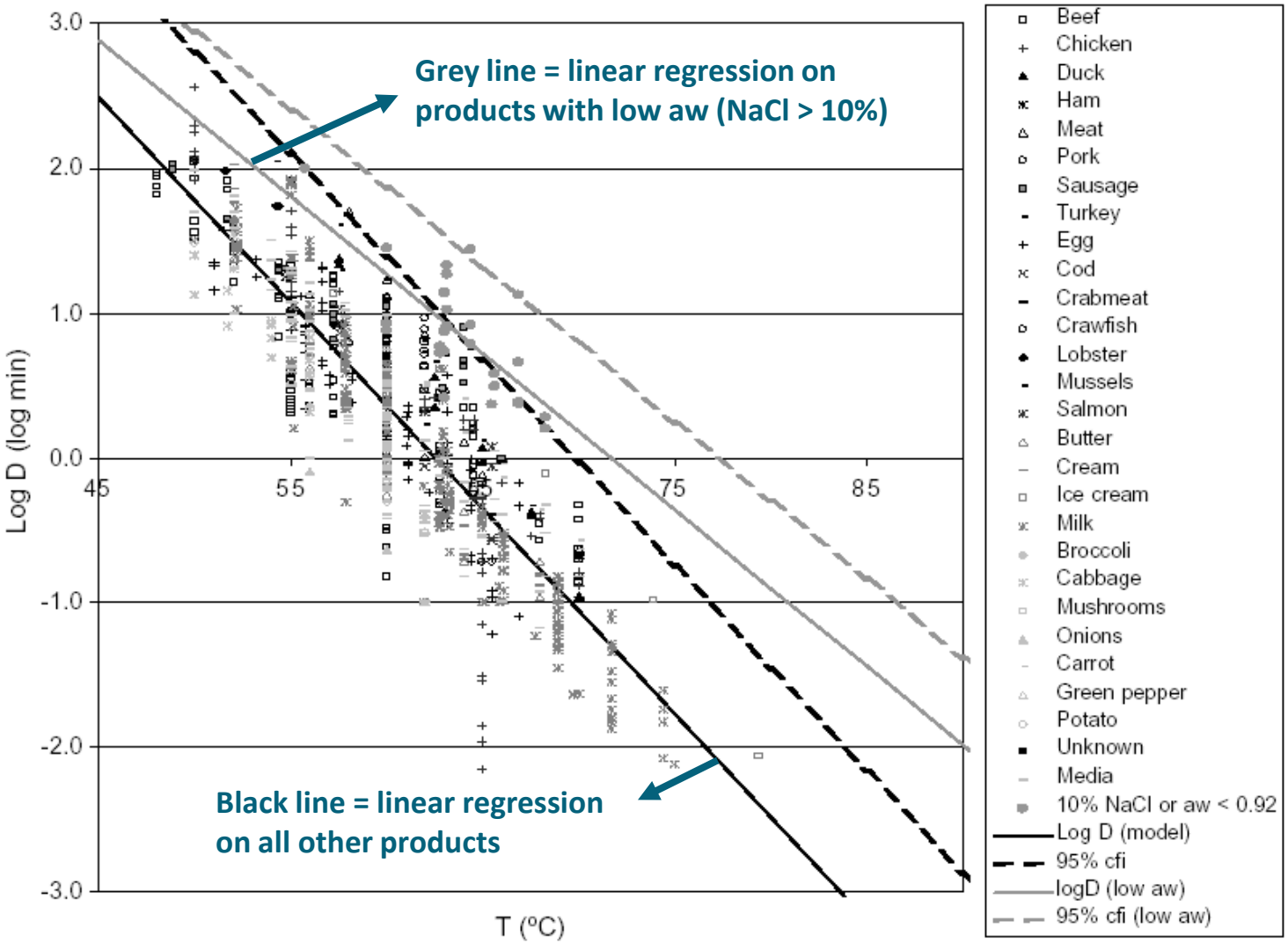
- Comparing these overall data, it can be seen that most factors reported to have an effect on the D-value **are smaller than the variability of all published data**

- From the statistical analyses performed, this study point out the main effects that have to be included for a first step on the performance of a heating process

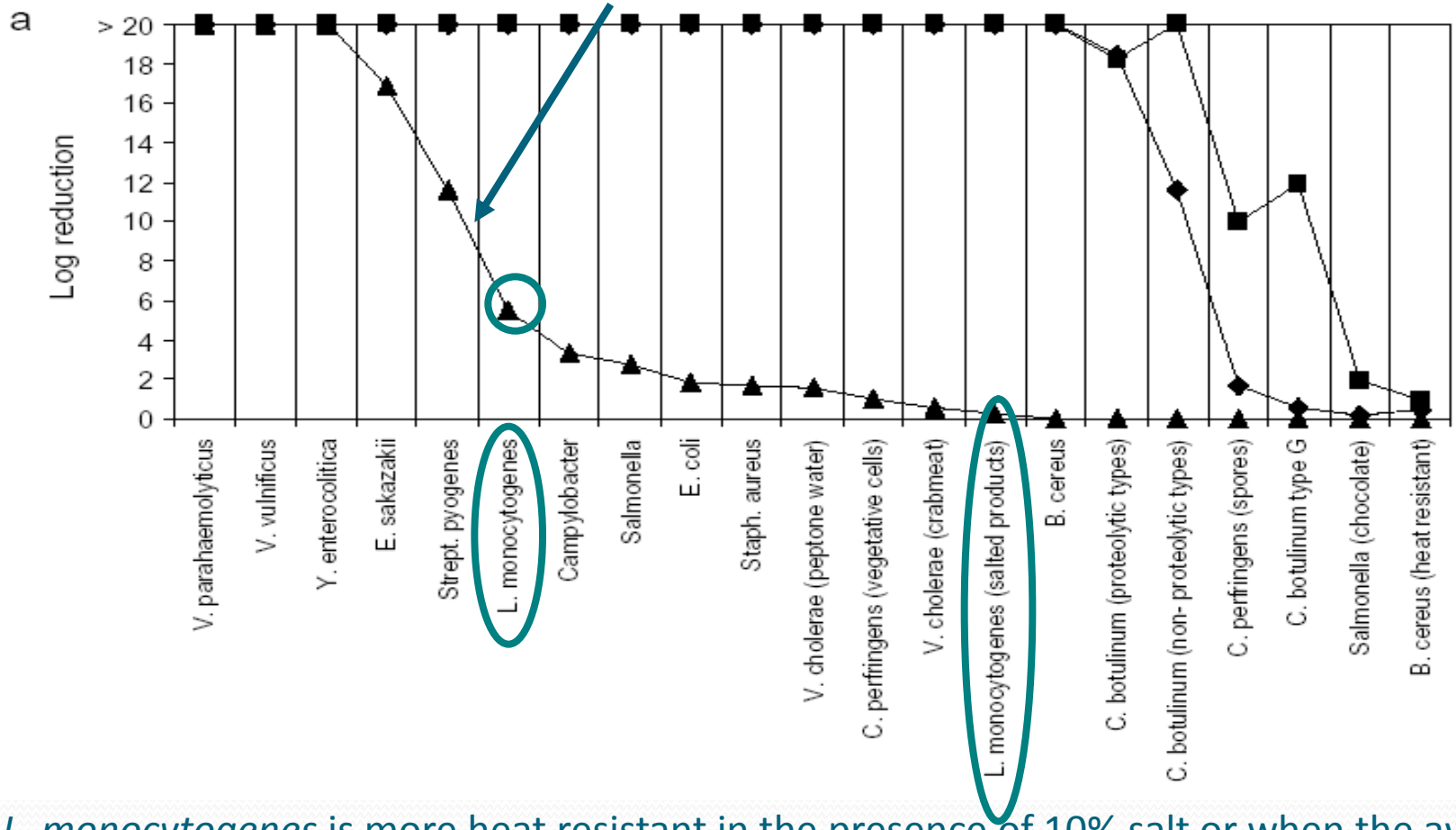
Mean log D-values at reference temperature T_{ref}, upper 95% PI for log D_{ref}- and z-values for various pathogens

Micro-organism	Product	T_{ref} (°C)	z (°C)	Log D_{ref} (mean) (min)	Log D_{ref} (95% PI) (min)	σ	n	References[b]
Bacillus cereus	Various	120	12.8	−1.38	−0.28	0.56	465	10, 22–26, 29, 34, 36, 48, 57
Bacillus cereus (heat resistant)[a]	Oily products[a]	120	12.1	0.53	1.54	0.48	19	10, 29, 34, 48
Campylobacter spp.	Various	70	12.3	−0.96	0.05	0.50	46	1, 25, 34, 68
Clostridium botulinum proteolytic types (ABF)	Various	120	10.2	−0.78	−0.32	0.23	176	1, 25, 34
Clostridium botulinum non-proteolytic types (BCEF)	Various	120	18.6	−1.47	−0.07	0.71	175	1, 25, 34, 37, 39, 45, 55, 56, 60
Clostridium botulinum proteolytic type G	Various	120	34.0	−0.60	−0.22	0.18	24	34
Clostridium perfringens spores	Various	120	16.8	−0.52	0.43	0.48	64	11, 25, 34, 51
Clostridium perfringens vegetative cells	Various	70	10.3	−0.42	0.32	0.37	146	34, 40, 41, 53, 59
Enterobacter sakazakii	Various	70	6.3	−1.51	−0.57	0.47	79	12, 21, 35, 52
Escherichia coli	Various	70	10.6	−0.67	0.54	0.62	382	1, 7, 12, 15, 17, 25, 28, 32–34, 49, 58, 62, 63, 65, 67
Listeria monocytogenes	Various	70	7.0	−1.06	−0.28	0.40	940	1, 8, 9, 13, 14, 18, 20, 25, 30, 31, 34, 46, 49, 50
Listeria monocytogenes	Salted (10%)	70	9.2	0.18	0.78	0.29	27	20
Salmonella spp.	Various	70	9.1	−0.83	0.59	0.72	1141	1, 2, 4, 7, 12, 16, 19, 25, 28, 34, 38, 43, 47, 49, 50, 61, 63, 66
Salmonella spp.	Chocolate	70	20.4	2.65	3.04	0.19	20	19, 34
Staphylococcus aureus	Various	70	8.8	−0.59	0.33	0.47	204	6, 25, 27, 34, 42, 54, 64, 66
Streptococcus pyogenes	Various	70	9.2	−1.45	−0.15	0.57	11	34
Vibrio cholerae	Crabmeat	70	16.7	−0.25	0.34	0.19	5	34
Vibrio cholerae	Peptone water	70	21.8	−0.72	−0.48	0.05	4	34
Vibrio parahaemolyticus, *Vibrio vulnificus*	Various	70	8.5	−2.24	−1.30	0.46	34	3, 5, 34
Yersinia enterocolitica	Various	70	6.2	−1.80	−0.91	0.44	63	1, 8, 25, 34, 44

Heat resistance of *L. monocytogenes* for various products and laboratory media



Log reduction of pathogens estimated with the mean log D values for a pasteurisation process (15 s at 72°C)



L. monocytogenes is more heat resistant in the presence of 10% salt or when the aw is below <0.92

It appears that, when data of various products and various conditions are combined, *L. monocytogenes* is overall less heat resistant than other pathogens

Conclusion

- The 95% upper prediction levels of the D-values estimated in this study can be used:

  - as a conservative estimate of inactivation and

  - to generally assess the performance of a heating step

- There is a significant main effect of aw (10% NaCl) on *Listeria monocytogenes* heat resistance

Thank you for your attention