What About *Listeria monocytogenes*?

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Chilled Food Association

RSPH 19/5/16 [updated 16/6/17]

- What is chilled food?
- Why is *Listeria monocytogenes* important?
- High risk foods and vulnerable groups
- Prevalence
- Controls
- What we want

Example of Real Enquiry

From Czech Republic:

- We are interested in R&D services to help us develop a range of 21 day life, chilled sandwiches.
- As shocking as it seems, short shelf life is the biggest reason why major retailers have refused my products - and I'm at P+12 already. ”

Chilled Food

A prepared food that
for reasons of safety and/or quality
is designed to be stored
at refrigeration temperatures
(at or below 8°C)
throughout its entire life

Ready to Eat	(RTE)
Ready to Reheat	(RTR)
Ready to Cook	(RTC)


What Are Chilled Foods?

UK Retail Chilled Prepared Food Industry

Year	Market (£m)
1989	550
1999	4550
2005	7357
2010	9163
2014	12280

Source: TNS/Kantar WorldPanel, CFA: www.chilledfood.org/market

UK chilled foods' unique position

- Retail own label dominate, but some manufacturer brands
- No manufacturer contracts
- Predominantly made in the UK
- Just in time – made on day of despatch to customer
- Significant annual churn – New Product Development
- Year-round supply
- Audited, specified suppliers – built-in traceability
- Unpreserved – apart from chilling - short shelf life
- HACCP from the outset
- Exacting microbiological standards

CFA CHILLED FOOD ASSOCIATION

What Makes Food Ready to Eat (RTE)?

- **Manufacturer's risk assessment & product design, i.e. HACCP plan:**
- **Appropriate production controls**
  - Minimise potential for contamination by zoonotic organisms – **4Cs**
- **Hygienic preparation and packing**
  - Prevent re-/cross-contamination
  - Process
- **Limited shelf life**
  - Ensure peak quality
  - Minimise opportunity for microbial growth
- **Chilled distribution, sale and storage**
  - Minimise potential for microbial growth
- **Appropriate usage instructions**
  - Durability date

Listeria monocytogenes (Lm)

- **The biggest cause of deaths from foodborne illness in the UK, EU and USA**
- Transmission from:
  - contaminated food
  - the environment
  - mother to foetus
- **Major transmission route to humans is…**
  - **contaminated food**

L. monocytogenes Ecology

- One of 18 *Listeria spp.* – Lm is the only species legislated for
- Widespread in the environment: soil, water, animal faeces, vegetation
- Carried by 10% of people
- Grows at refrigerator temperatures
- Grows in low O_2 environments, e.g. vacuum packed foods
- Highly salt tolerant – survives and grows in cured foods
- Can survive freezing
- Relatively heat resistant (70°C/2 mins for 6-log reduction)
- Long incubation period – up to 90 days before symptoms appear
- Forms persistent biofilms on surfaces
  - Resistant to cleaning and disinfection
  - Creates reservoir of contamination
  - **Must enforce rigorous hygiene**

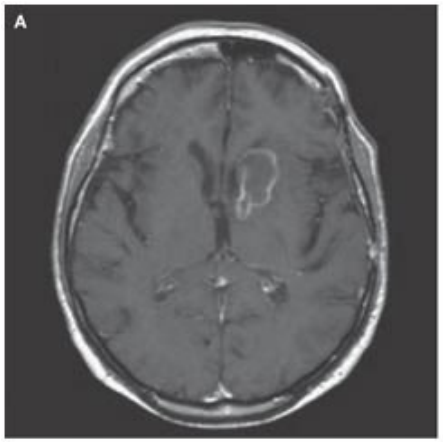
Factor	Growth			Survival
	Lower Limit	Optimum	Upper Limit	
Temp (°C)	-1.5 to 3.0	30-37	45	-18
pH	4.2-4.3	7	9.4-9.5	3.3-4.2
aW	0.90-0.93	0.99	>0.99	<0.90
NaCl (%)	<0.5	0.7	12-16	>20
Atmos.	Facultative anaerobe – survives $\pm O_2$			

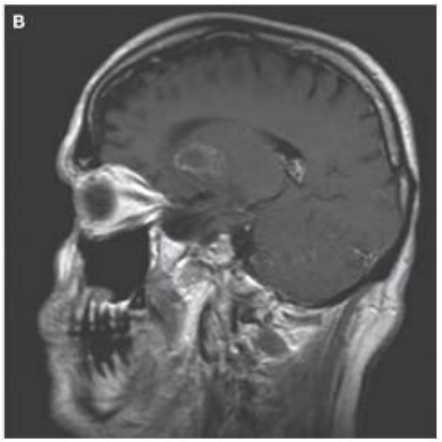
Listeriosis

- **Invasive:**
  - Similar to meningitis, blood infections, septicaemia, local infections

- **Non-invasive:**
  - Can sometimes only cause febrile gastroenteritis

- **England & Wales (2008-13):**
  - Bacteraemia in 79% cases





Listeriosis

The biggest cause of foodborne illness deaths in the UK, EU & USA

2015 EFSA/ECDC Data

2015 Data Disease	No. confirmed human cases	Hospitalisations			Deaths			
		*No. reporting MS	Reported cases	Rate (%)	*No. reporting MS	Reported deaths	Case fatality (%)	*v.* Lm
Campylobacteriosis	229,213	17	19,302	31.2	16	59	0.03	590
Salmonellosis	94,625	16	12,353	38.4	16	126	0.24	74
Yersiniosis	7,202	14	530	30.9	14	0	0.0	
VTEC infections	5,901	14	853	36.3	15	8	0.24	74
Listeriosis	2,206	18	964	97.4	20	270	17.7	

Listeriosis death rate 590x Campylobacteriosis, 74x STEC (2015)

* Not all countries observed cases for all diseases

EFSA, ECDC, 2016. EU summary report on trends and sources of zoonoses, zoonotic agents and food-borne outbreaks in 2015. EFSA Journal 2016. 10.2903/j.efsa.2016.4634

Comparing European Countries' Listeriosis Rates

2014 & 2015

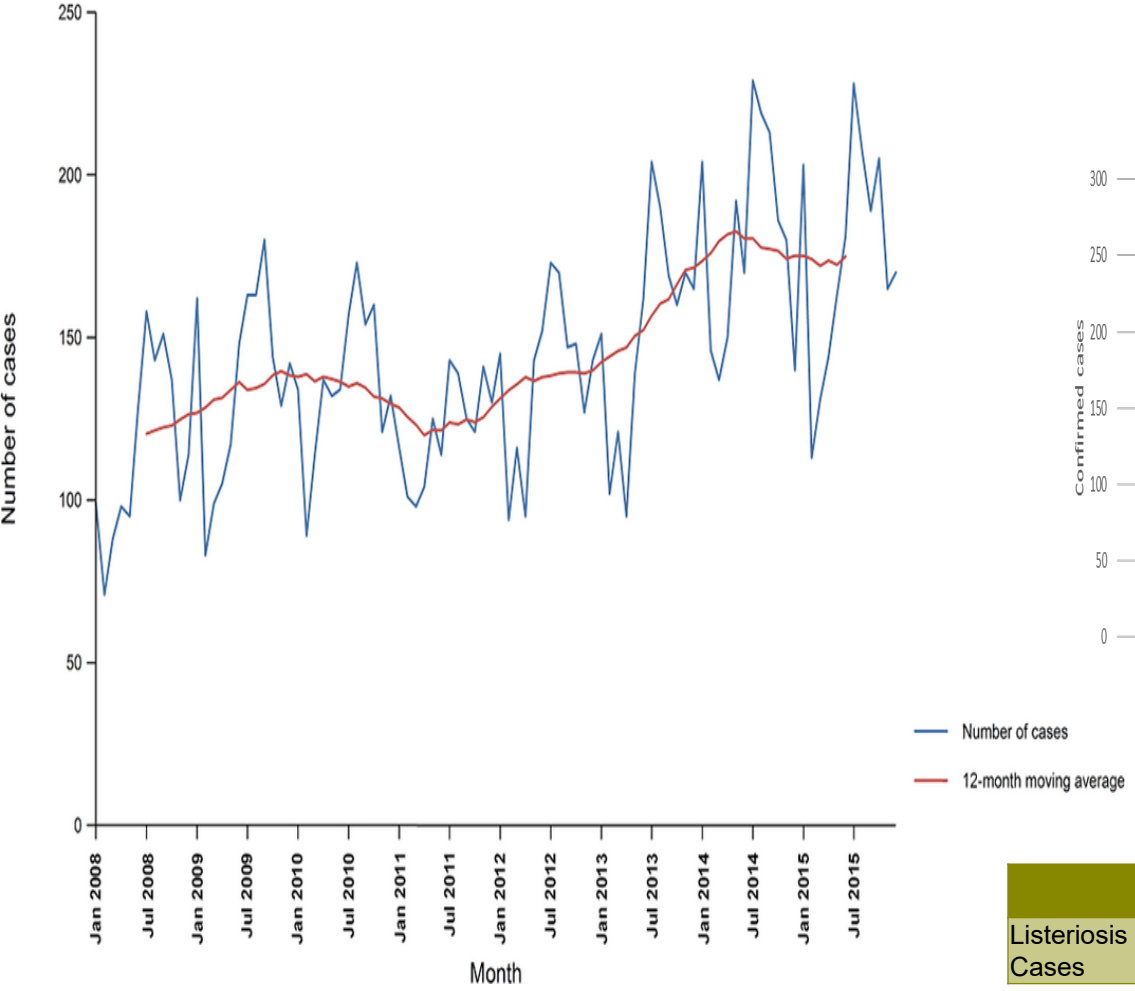
2014	Cases	Rate
Italy	52	-
Portugal	-	-
Denmark	92	1.64
Sweden	125	1.30
Iceland	4	1.23
Switzerland + Liechtenstein	98	1.20
Finland	65	1.19
Spain	161	1.15
Luxembourg	5	0.91
Slovenia	18	0.87
Belgium	84	0.75
Germany	597	0.74
Austria	49	0.58
France	374	0.57
Norway	29	0.57
Netherlands	90	0.54
Slovakia	29	0.54
EU Total	2,161	0.52
Hungary	39	0.40
Czech Republic	38	0.36
Ireland	15	0.33
UK	201	0.31
Lithuania	7	0.24
Malta	1	0.24
Poland	86	0.23
Latvia	3	0.15
Bulgaria	10	0.14
Greece	10	0.09
Croatia	4	0.09
Estonia	1	0.08
Romania	5	0.03
Cyprus	0	0.00

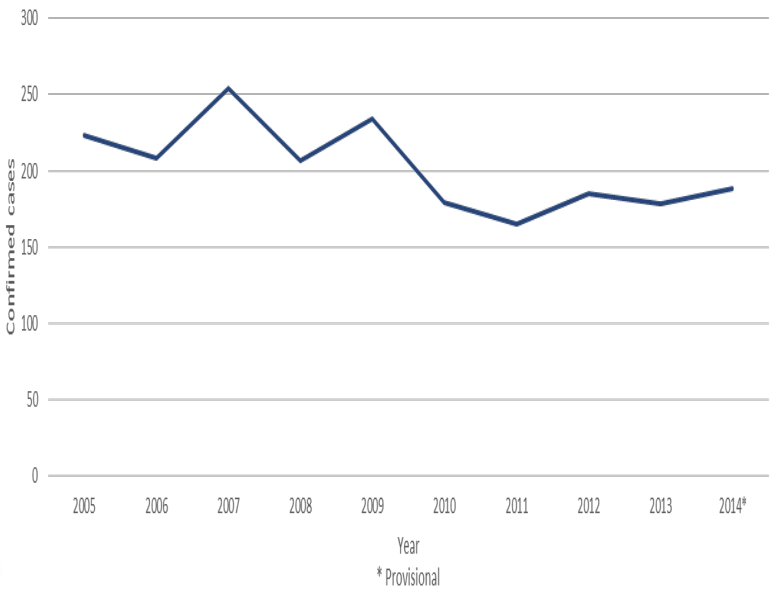
2015	Cases	Rate
Spain	206	0.99
Malta	4	0.93
Sweden	88	0.90
Finland	46	0.84
Estonia	11	0.84
Denmark	44	0.78
Belgium	83	0.74
Germany	580	0.71
Switzerland + Liechtenstein	54	0.65
Slovenia	13	0.63
France	412	0.62
EU Total	2,206	0.46
Austria	38	0.44
Netherlands	71	0.42
Ireland	19	0.41
Latvia	8	0.40
Hungary	37	0.38
Norway	18	0.35
Czech Republic	36	0.34
Slovakia	18	0.33
UK	186	0.29
Greece	31	0.29
Portugal	28	0.27
Italy	153	0.25
Poland	70	0.18
Lithuania	5	0.17
Bulgaria	5	0.07
Romania	12	0.06
Croatia	2	0.05
Cyprus	0	0
Luxembourg	0	0
Iceland	0	0

ecdc
EUROPEAN CENTRE FOR DISEASE PREVENTION AND CONTROL

efsa
European Food Safety Authority

Listeriosis: EU/EEA vs UK Trends





Case fatality rate 20 – 25%

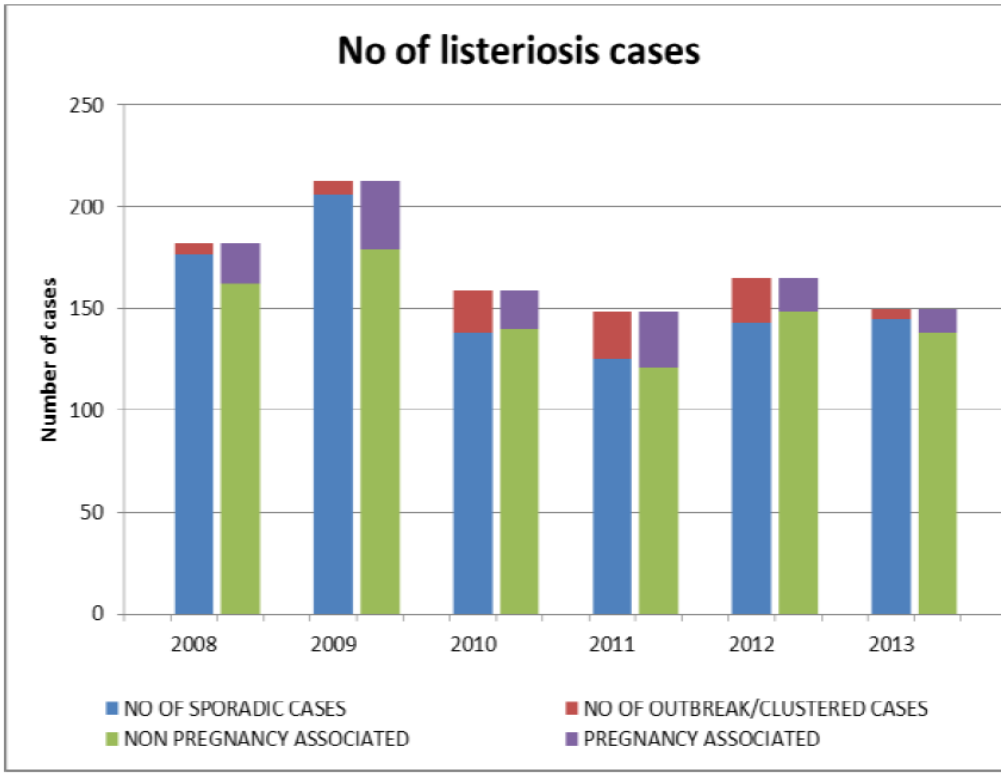
	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014*
Listeriosis Cases	223	208	254	207	234	179	165	185	178	188

EFSA Journal
Volume 14, Issue 12, 16/12/16 DOI: 10.2903/j.efsa.2016.4634
http://onlinelibrary.wiley.com/doi/10.2903/j.efsa.2016.4634/full#efs24634-fig-0025

Zoonoses Summary Report 2014, Defra

Listeriosis in the UK

- **UK lab-confirmed cases:**
  - 1990-2000: 114-136 p.a.
  - 2000-2009: doubled
  - 2014:
    - 201 cases reported to EFSA/ECDC
    - 188 cases in Defra zoonoses report



- ***2008-2013, England and Wales**:
  - 1017 cases reported
  - 129 pregnancy-related
  - 54% cases were males
  - 64.7% were >60 years of age
  - 17 outbreaks/clusters investigated (83 cases)

*** Epidemiology of listeriosis in England and Wales between 2008 and 2013. ACMSF. ACM/1135, January 2014**

Fatal Listeriosis Outbreaks

- Canada (1981): 17 deaths, 41 cases. Coleslaw

- USA (1985): >47 deaths, 86 cases. Queso fresco

- UK (1987-9): >17 deaths, 200+ cases. Pâté

- France (1993): 9 deaths, 38 cases. Cooked meat (pork rillettes)

- USA (1998-9): 14 deaths, 4 miscarriages/stillbirths, 100+ cases. Cooked meat. Contaminated air filtration unit?

- UK (2007): Catered sandwiches

- Canada (2008): 22 deaths, 57 cases, CAD 27m. Cooked sliced meat. Retirement homes and hospitals. Dirty slicer.

- USA (2011): 33 deaths, 147 cases, USD 50m. Cantaloupes. Equipment and water contaminated.

- UK (NI) (2012): 3 deaths. Hospital-catered sandwiches

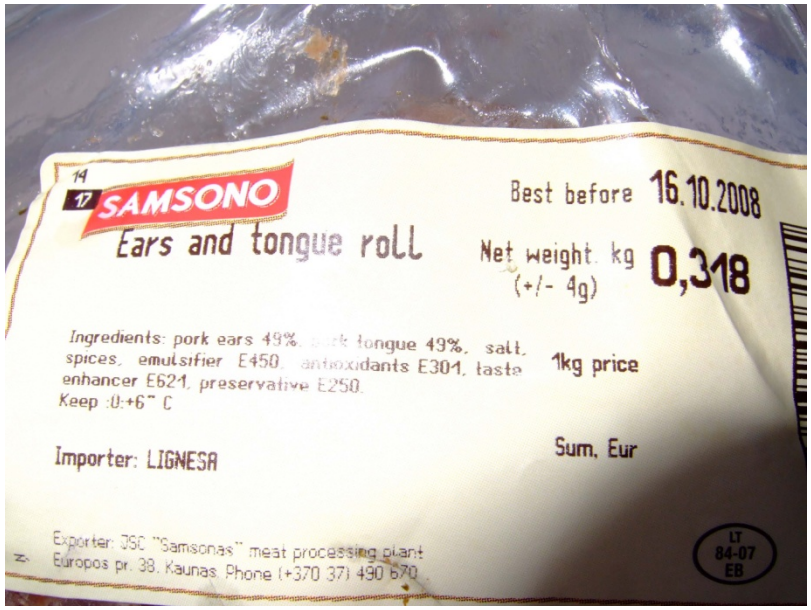
- Denmark (2014): 17 deaths, 41 cases. Cooked meat (rullepølse)

- USA (2010-15): 3 deaths, 10 cases. Ice cream

Notable Recalls from the UK Market

Ear & Tongue Roll

Lithuanian import - >3 x 10^6 cfu/g
Best before 16/10/08, Recall 22/10/08



http://www.food.gov.uk/news/newsarchive/2008/oct/samsono

Home Black Pudding Sausage

Polish import – 6 x 10^5 cfu/g
Use by 30/10/10, Recall 20/10/10

www.food.gov.uk/enforcement/alerts/2010/oct/sokolowssausage

Vulnerable Groups

- **People with weakened immune systems are particularly susceptible to listeriosis, and likely to suffer more severe symptoms**

- **Vulnerable groups include:**
  - cancer patients
  - patients undergoing immunosuppressive or cytotoxic treatment
  - unborn and newly delivered infants
  - pregnant women
  - people with diabetes
  - alcoholics (including those with alcoholic liver disease)
  - people using gastric acid inhibitors*
  - the elderly

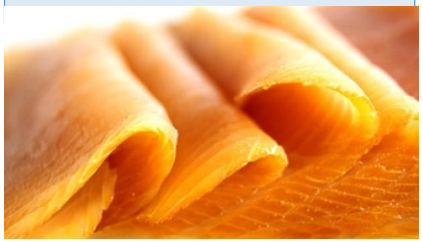
- **Proportion of population in vulnerable group?**

* Risk factors for sporadic listeriosis in the Netherlands, 2008 to 2013. Euro Surveill. 2015;20(31):pii=21199

Foods of Particular Risk to Vulnerable Groups

Fish

- Smoked fish
- Cooked shellfish
- Pate



Meat

- Cooked (sliced) meats/poultry
- Pate
- Cured meats

Pasteurised/ unpasteurised cheeses

- Soft blue veined
- Mould ripened soft

Prepared foods

- Pre-packed sandwiches
- Prepared salad veg
- Some cut fruits e.g. melon

Generally high risk:

- **Chilled, and**
- **Ready to eat, and**
- **Able to support the growth of Lm (proteinaceous foods - free amino acids required for Lm growth)**

UK Listeriosis Cases/Clusters

Year	Region	Cases	Vehicle
1999	NE England	4	Hospital sandwiches
2003	NE England	17	Butter
2003	NE England	18	None identified
2003	S Wales	2	Hospital sandwiches
2003	SW England	5	Hospital sandwiches
2004	E Mids	6	None identified
2004	SE England	2	Hospital sandwiches
2005	NW England	1	Sliced meat
2006	London	1	Sliced meat
2007	London	1	Hospital sandwiches
2011	Staffordshire	3	Hospital sandwiches
2012	Northern Ireland	3	Hospital sandwiches

→ FSA 2016 guidance for healthcare settings

ACM 847a (ACMSF) 2007, Eurosurveillance 16 (20) May 2011 + supplementary information

Lm Prevalence in RTE Foods

- **Higher prevalence in:**
  - Food sliced to order (e.g. delicatessens) *cf* pre-packed retail
  - Loose (non-prepacked) foods without clear storage/usage instructions
  - Food from sandwich bars, butchers, convenience shops, bakeries, i.e. produced and sold by smaller businesses
  - **Foods produced by businesses with less well developed hygiene systems resulting in reduced protection from re- or cross-contamination**

	*Mar–Sep 2007 (FSA B18024)	Apr 2012-Mar 2013 (FSA FS241042)	HPA/LACORS Survey May 2006-April 2007	
	Cooked sliced meat sold by **SMEs & major retailers	Cooked sliced meat sold by SMEs	Supermarket pre-packed	Sandwich bar
Lm	1.5%	3.8%	1.4%	5.7%

* 2/3 of ~1600 samples from major retailers

**SMEs = small and medium-sized enterprises

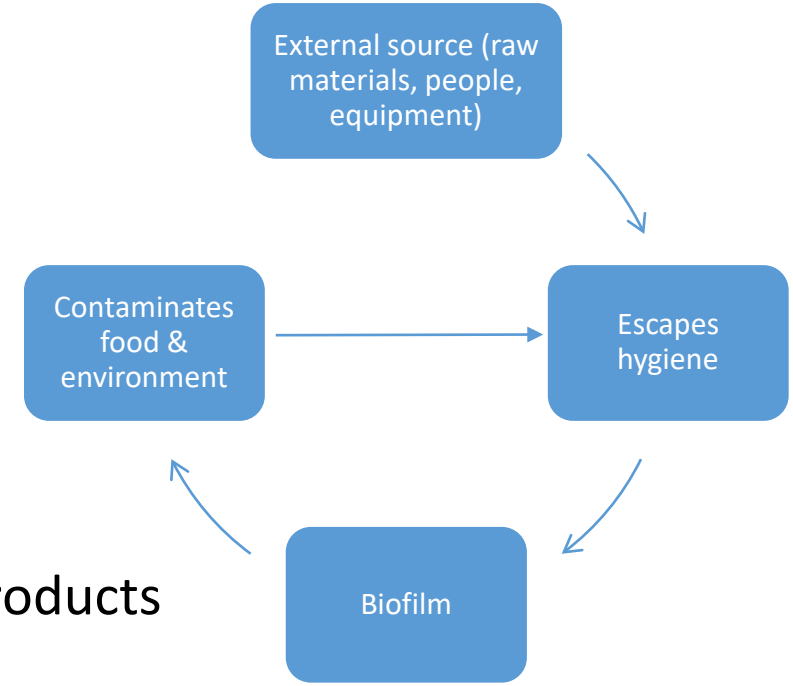
European High Risk Food Lm Prevalence

13088 food samples across the EU*

		Lm prevalence	>100/g
Fish	'At point of sampling'	10.40%	1.00%
Fish	End of shelf-life	10.30%	1.70%
Meat	End of shelf-life	2.07%	0.43%
Cheese	End of shelf-life	0.47%	0.06%

Analysis of the baseline survey on the prevalence of *L monocytogenes* in certain ready-to-eat foods in the EU, 2010-2011 Part A: *L. monocytogenes* prevalence estimates, EFSA Journal 2013;11(6):3241

L. monocytogenes Ecology



Lm enters a factory (e.g. staff, raw materials)

Drains = hotspot unless take special measures

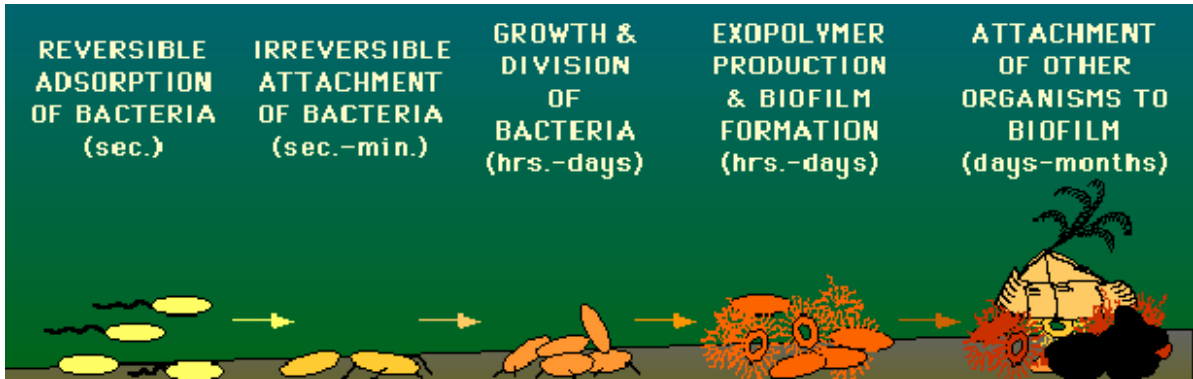
Spreads onto equipment, persists

Persistent strains mostly isolated from final products

Lm can adhere to equipment materials commonly used in the food industry, and form biofilms

Robust hygiene systems

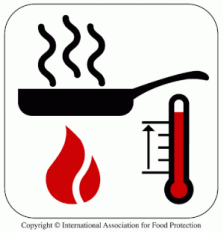
- **Clean**
- **Disinfect**

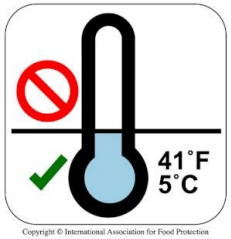


Controls:

Basic Food Safety Rules

- **The 4Cs:**
  - Clean
  - Cook
  - Avoid Cross-Contamination
  - Cold/chill





- **5th rule:**
  - Use good quality raw materials/ingredients

Cleaning (& Disinfection)

- **Ensuring food production environment cleanliness is a fundamental requirement of food hygiene legislation (and a CCP)**

- **EC General Food Hygiene Regulation 852/2004:**
  - Chapter V, 1: *All articles, fittings and equipment with which food comes into contact are to: (a) be effectively cleaned and, where necessary, disinfected. Cleaning and disinfection are to take place at a frequency sufficient to avoid any risk of contamination…*

  - HACCP principles – Art 5: establish, validate and monitor efficacy of cleaning and disinfection (CCP)

Cleaning (& Disinfection)

- **Pennington Reports (1997 & 2009)**
- **Importance of providing clear information on cleaning and disinfection to food businesses:**

  - Lanarkshire outbreak butcher thought biodegradable detergent was a bactericide… led him to contaminate the whole of his premises and many cooked products with *E.coli* O157. [1997 report]

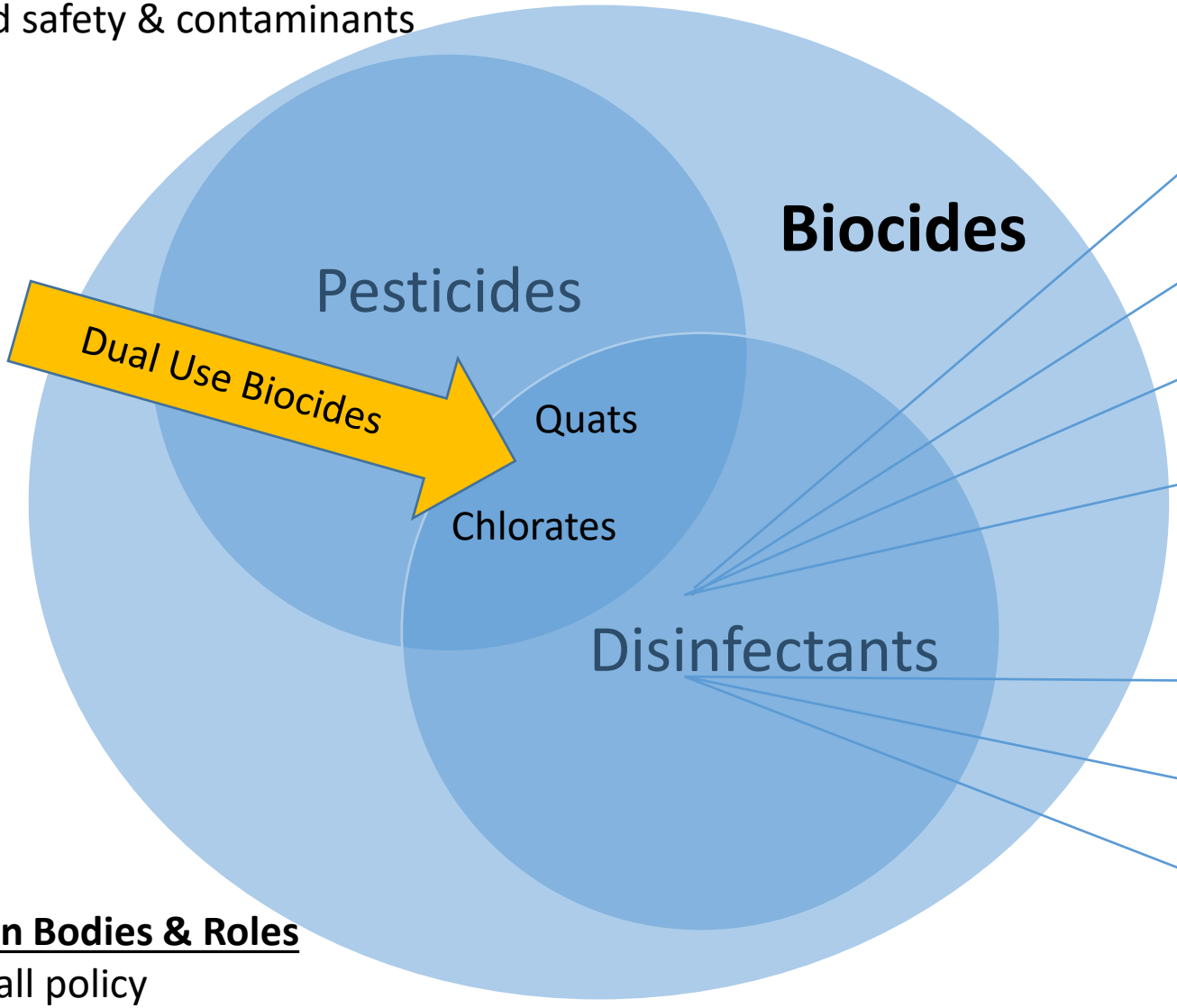
  - FSA should remove the confusion that exists among FBOs about what solution(s) should be used to prevent cross-contamination from surfaces and equipment. [Recommendation 6, 2009 report]

UK Government Bodies & Roles

Local Authorities: hygiene enforcement (no role with pesticides)

HSE: biocides inc pesticides enforcement

FSA: food safety & contaminants



***Food-related uses:**

- Containers
- Equipment
- Floors etc
- Water inc produce washing
- Hands
- Transport
- Utensils

European Bodies & Roles

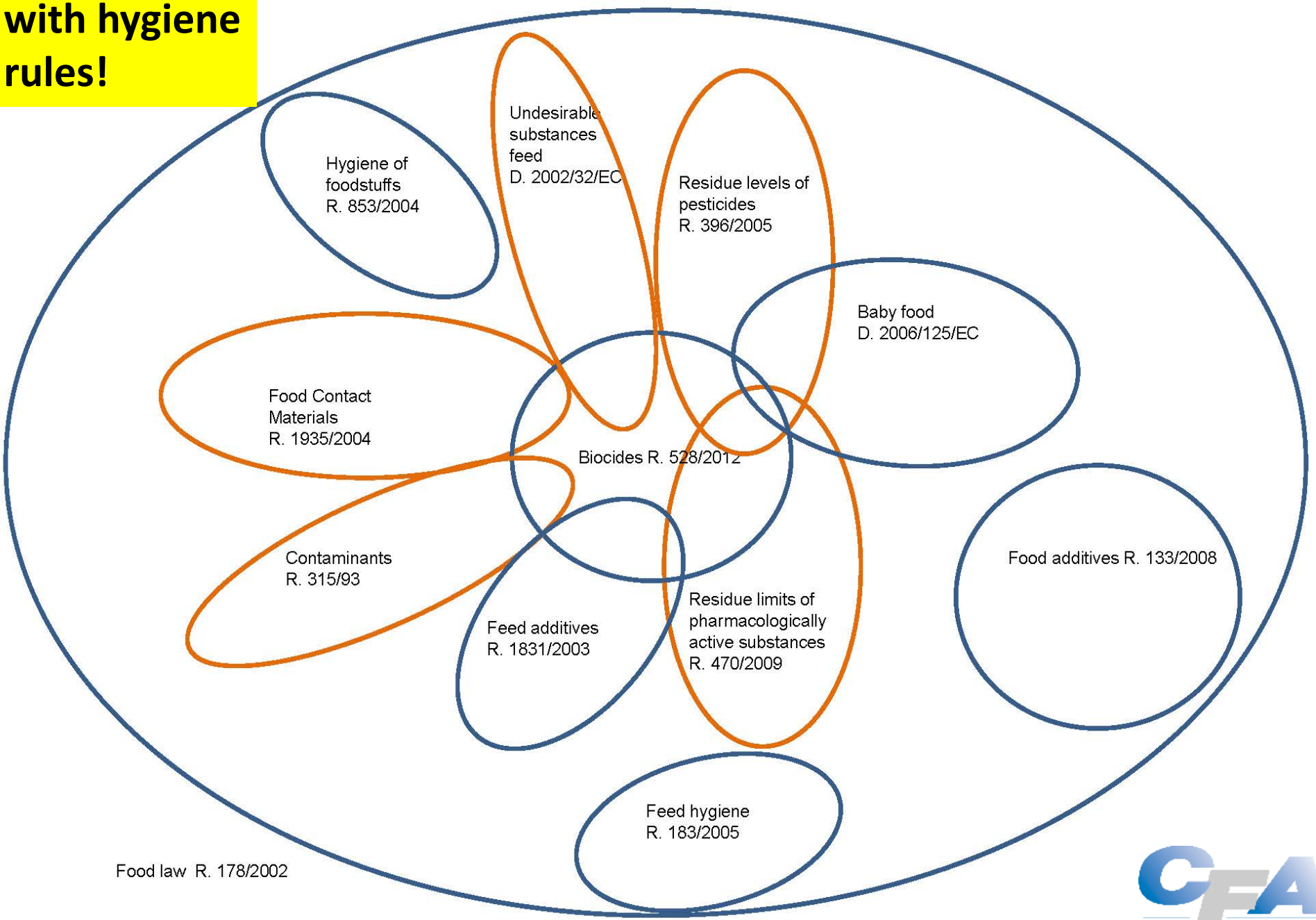
EC: overall policy

EU Chemicals Agency (ECHA): Biocidal Products Reg

EU Food Safety Authority (EFSA): food & pesticides safety

* Manufacture, foodservice, hospital catering, retail

No linkage with hygiene rules!



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Efficacy of sanitisers vs. *L. monocytogenes* on poorly & properly cleaned surfaces or suspensions

Sanitiser type	In absence of protein residues (effective cleaning)				In presence of protein residues (poor cleaning)			
	No. studies reviewed	No. observations	Total no. replicates	Mean reduction (log cfu)	No. studies reviewed	No. observations	Total no. replicates	Mean reduction (log cfu)
Halogen	3	27	124	3.8	2	9	60	2.4
Hypochlorite	11	321	891	5.5	4	38	117	2.8
Peracetic acid	6	177	484	4.6	2	24	52	3.8
Quaternary ammonium	5	59	262	6.1	2	8	56	5.3

Adapted from: http://safesmokedfish.foodstandards.gov.scot/assessment/5130

Biocides – CFA Action

- **Established and leading UK Food & Biocides Industry Group**

Food & Biocides Industry Group

CFA/043/16

Biocides in Cleaning and Disinfection – Working Document

www.chilledfood.org/FBIG

Contents

Tables

Cold (+ Time)

2073/2005 Micro Criteria Reg Annex II - Shelf Life Studies

- **The studies shall include:**
  - specifications for physico-chemical characteristics of the product, such as pH, aW, salt content, concentration of preservatives and the type of packaging system, **taking into account the storage** and processing conditions, the possibilities for contamination and the foreseen shelf-life….

Comparing Shelf Lives

	UK	Other EU	USA
Delicatessen meat	10-15 d (uncured) 15->30 d (cured) [major retailers]	14-28 d(uncured) 14-56 d(cured)	28-84 d
Sandwiches	2 d [major retailers]	≤14* d	≥ 23 d
	4 d [airline]		
	10 d [discounter]		
Cold-smoked salmon	21-24 d	≤120 d	≤120 d

Fundamentally the same food so why such different shelf lives?

Answer: **Use of preservatives, shelf life protocol variability, lack of shelf life validation + reacting to commercial demands**

* Fillings generally low a_w

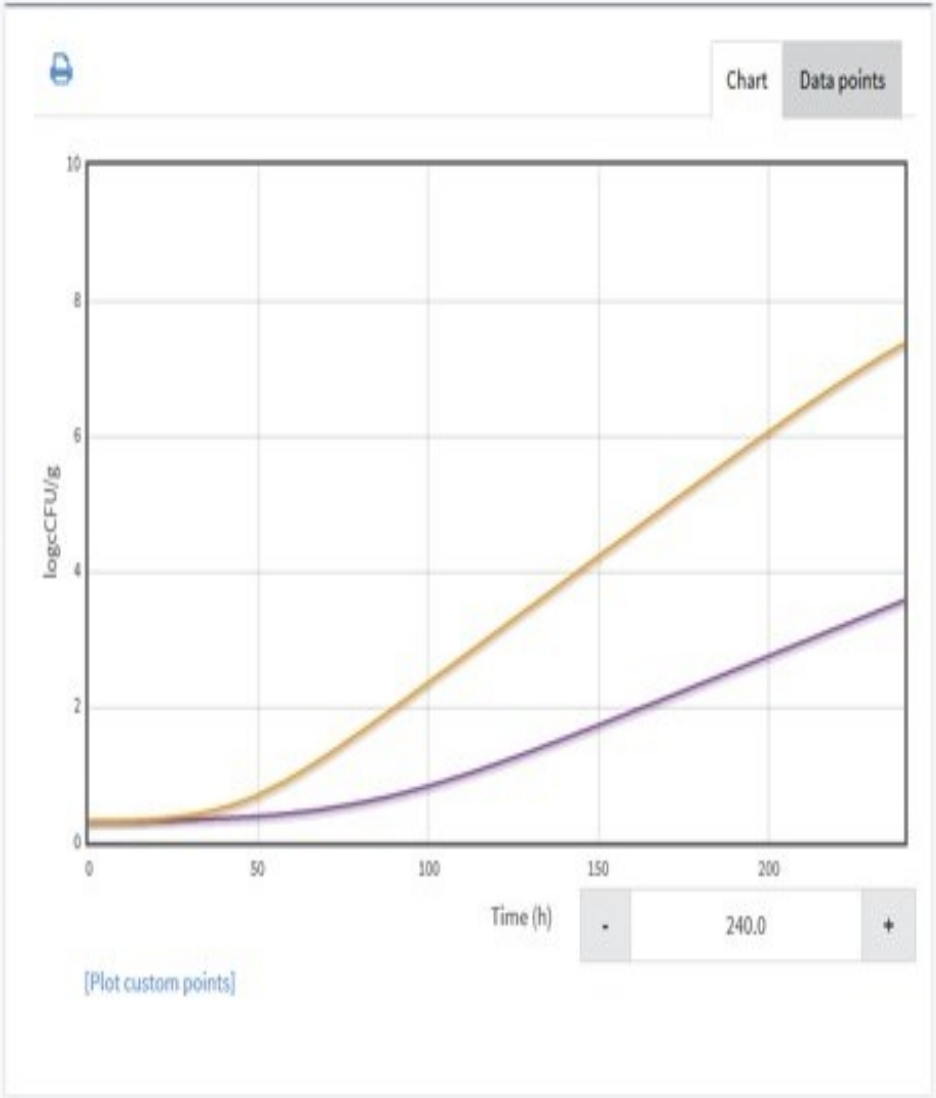
Cold (+ Time)

2073/2005 Micro Criteria Reg Annex II - Shelf Life Studies

- **The studies shall include:**
  - specifications for physico-chemical characteristics of the product, such as pH, aW, salt content, concentration of preservatives and the type of packaging system, **taking into account the storage** and processing conditions, the possibilities for contamination and the foreseen shelf-life…..
  - consultation of available scientific literature and research data regarding the growth and survival characteristics of the micro-organisms of concern.
  - **predictive mathematical modelling… using critical growth or survival factors for micro-organisms of concern in the product**

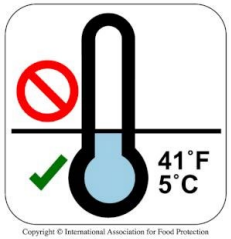
e.g. http://ComBase.cc

Predictive modelling: http://ComBase.cc
Effect of temperature on Lm growth rate



~double Lm growth rate at 8°C *cf* 5°C
(~3x at 10°C *cf* 5°C)

Temperature: Domestic Fridges



Temperature reported (°C)	Number of fridges at specified temperature	% fridges at specified temperature	Cumulative %
<4°C	143	4	4
4.0-4.9°C	1,255	34.8	38.8
5.0-5.9°C	120	3.3	42.1
6.0-6.9°C	24	0.7	42.8
7.0-7.9°C	1,356	37.6	80.4
8.0-8.9°C	68	1.9	82.3
9.0-9.9°C	633	17.5	99.8
≥10°C	8	0.2	100

Of 3,607 domestic refrigerators (consolidated surveys) worldwide 39% were <5°C, 80% were <8°C. Mean European and UK temperature 6.6°C

Source: *Cl botulinum* in vacuum and modified atmosphere packed (MAP) chilled foods (FSA Project **B13006**)

What We Want

- **Implementation and enforcement of current rules and guidance by all RTE foods FBOs:**
  - **Hygiene legislation 852/2004**
    - **Segregation: Apply GMP + HACCP, i.e. High Care/Risk Area regimes - demonstrably effective control strategy**
    - **Cleaning and disinfection: Maintain access to effective biocides to assure food hygiene and safety. Legislators must fully consider hygiene**
  - **Micro Criteria for Foodstuffs 2073/2005**
    - **Environmental sampling - trending**
    - **Sampling RTE foods**
    - **Scientific basis for shelf life establishment**
- **Enhanced domestic refrigeration performance**

HACCP in Practice – CFA Guidance

- **CFA Best Practice Production Guidelines:**
  - www.tsoshop.co.uk/chilledfoods
  - Covers all chilled prepared foods
  - Integrates with BRC Global Standard and IFS
- **CFA Lm Management Guidance:**
  - Best hygiene practice, methodology, implementation (members only)
- **UK Food & Biocides Industry Group**
  - Biocides in Cleaning & Disinfection: http://preview.tinyurl.com/FBIG-biocides-guidance
- **Microbiological testing - application & interpretation:**
  - New edition out soon
- **EU Microbiological Criteria Regulation 2073/2005:**
  - CFA/BRC guidance: http://preview.tinyurl.com/yaxr9ss
  - CFA/BRC Lm & shelf life guidance: http://preview.tinyurl.com/ycyyydu

CHILLED FOOD ASSOCIATION

The centre of excellence for the chilled food industry

www.chilledfood.org

www.chillededucation.org