Listeria monocytogenes and Shelf Life

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REHIS, 19/10/11
Programme

- UK retail chilled prepared food industry
- CFA membership and strategy
- *Listeria monocytogenes* and listeriosis
- Highest risk foods
- Controls used by professionals and their efficacy
- What we want
- Guidance available
UK Retail Chilled Prepared Food Industry

<table>
<thead>
<tr>
<th>Year</th>
<th>Market (£m)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1989</td>
<td>550</td>
</tr>
<tr>
<td>1999</td>
<td>4550</td>
</tr>
<tr>
<td>2005</td>
<td>7357</td>
</tr>
<tr>
<td>2010</td>
<td>9163</td>
</tr>
</tbody>
</table>

Chilled foods’ unique position

- Retail brand dominance, although brands now emerging
- No manufacturer contracts
- Unpreserved
- Just in time
- HACCP from the outset
- Exacting microbiological standards
- Significant annual churn
- Predominantly made in the UK
Chilled Food Association

• Who are we?
  – Represent professional manufacturers supplying UK market

• What is our Mission?
  – To promote and defend the reputation and value of the professional chilled food industry through the development and communication of standards of excellence in the production and distribution of chilled food

• With whom do we work?
CFA – Our Partnerships

[Logos of various partner organizations]
Membership Strategy

To attract members who

- Are professional chilled food manufacturers and chilled component/raw material suppliers

- Demonstrable competence
  - Meet CFA Guidelines standards
  - Are certificated to appropriate technical standards
    - Non-conformances and close-outs
  - CV of the person responsible for food safety
  - Supporting reference from existing members

- Minimum £20m chilled turnover
CFA Standards Strategy

- CFA promotes Members
- Members promote Suppliers
- CFA promotes Retailers
- CFA requires Applicant Members
- CFA promotes Government
What Are Chilled Foods?
UK Chilled Prepared Food Ranges

- Dressed salads
- Leafy salads
- Prepared Vegetables
- Prepared fruit
- Stir fry kits
- Sandwiches and wraps
- Sandwich fillings
- Quiche/flans

- Pizza
- Recipe dishes/kits
- Meal Accompaniments
- Sushi
- Filled and plain fresh Pasta
- Soups (some RTE)
- Sauces
- Desserts

Items in green = ready to eat
Ready to Eat Food = ?

Defined in Regulation 2073/2005 as:

“food **intended by the producer or the manufacturer for direct human consumption** without the need for cooking or other processing effective to reduce to an acceptable level or eliminate microorganisms of concern.”
Not included in CFA’s scope:

- **Meat, e.g.**
  - Raw or air-dried
  - Cooked or cured
- **Dairy products, e.g.**
  - Milk (fresh or fermented)
  - Cheese
- **Fish, e.g.**
  - Unprocessed raw whole/fillets

BUT... chilled prepared foods may include these ingredients
Listeria monocytogenes

- One of 6 spp of *Listeria* (mono, innocua, welshimeri, seeligeri, ivanovii, grayi)
- Gram-positive rod-shaped bacterium
- Most strains pathogenic
- Most heat resistant vegetative pathogen \( (6D = 70^{\circ}C / 2 \text{ mins}) \)
- Facultative anaerobe
- Relatively cold tolerant
- Relatively salt tolerant
- Only Lm is specifically legislated for
Lm Distribution

• Occurs naturally in soil, sewage, silage, gut of many animals, raw meats

• Estimated that 10% of healthy adults carry in gut

• Transmission from
  – infected food
  – the environment
  – mother to foetus

• **Major transmission route into humans is through contaminated foodstuffs**
Listeriosis - the commonest cause of food-related deaths in the UK

• ‘Flu-like, septicaemia, meningitis, spontaneous abortion
  - Immunosuppressed: meningitis-encephalitis ± brain abscess
  - Adults: bacteraemia, sometimes with organ abscesses
  - Pregnant women: often → foetus infection, stillbirth

• Hospitalisation rate: 85-90%

• Death rates:
  - meningitis ~70%
  - septicaemia 50%
  - perinatal/neonatal >80%

• Infective dose variability between strains (5-fold?)

• Long incubation period: 3-70 days (source ID?)
Listeriosis – Epidemiology

• Changes
  – Incidence approx doubled since 2001
  – Mainly in 60+ group
  – Bacteraemia without CNS infection
  – This increase has continued into 2009

• Cannot be explained by
  – Recognised outbreaks
  – Regional differences
  – Age
  – Gender or
  – A predominant Lm subtype

• Other European countries report similar increases

Source: ACM979
Listeriosis - Risk Factors

• More likely to report consumption of:
  - cooked meats (beef and ham/pork; not poultry)
  - cooked fish (i.e. (cold?) smoked salmon) & shellfish (prawns)
  - dairy products (i.e. milk but also certain cheeses)
  - ‘mixed salads’

• More likely to be bought from:
  - convenience stores & local shops (bakers, butchers, fishmongers and greengrocers)

• Incidence higher in most deprived areas
  - Observed in patients aged 60+
  - More marked for pregnancy-associated cases

• Pregnancy-associated cases increasingly ‘ethnic’
  - 16.7% to 57.9% from 2001-8, most marked 2006-8
Recent Recalls from the UK Market

**Ear & Tongue Roll**
Lithuanian import - $2.8 \times 10^6$ cfu/g
Use by 16/10/08, Recall 22/10/08

**Home Black Pudding Sausage**
Polish import - $6 \times 10^5$ cfu/g
Use by 30/10/10, Recall 20/10/10

[Image of Ear & Tongue Roll]
[Image of Home Black Pudding Sausage]

Prevalence in UK RTE Foods

- Higher prevalence in food sliced to order than pre-packed
- Greatest prevalence
  - Non-prepacked foods without clear storage/usage instructions
  - Food from sandwich bars, butchers, convenience shops, bakeries
  - Sandwiches (7%) & sliced meats (3.7% within s/life, 4.2% @ end)
- ‘Consumer at risk' score inversely proportional to prevalence:

<table>
<thead>
<tr>
<th>Premises Type</th>
<th>Total No. Samples n= 6299 (%)</th>
<th>No. Samples Unsatisfactory n = 55 (%)</th>
<th>Samples with all Listeria spp. n = 296 (%)</th>
<th>Samples with Lm n = 137 (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Bakery</td>
<td>217 (3.5)</td>
<td>12 (5.5)</td>
<td>18 (8.3)</td>
<td>8 (3.7)</td>
</tr>
<tr>
<td>Butcher</td>
<td>140 (2.2)</td>
<td>3 (2.1)</td>
<td>17 (12.1)</td>
<td>6 (4.2)</td>
</tr>
<tr>
<td>Convenience shop</td>
<td>1331 (21.1)</td>
<td>15 (1.1)</td>
<td>92 (6.9)</td>
<td>55 (4.1)</td>
</tr>
<tr>
<td>Delicatessen</td>
<td>201 (3.2)</td>
<td>4 (1.9)</td>
<td>5 (2.5)</td>
<td>1 (0.5)</td>
</tr>
<tr>
<td>Farm shop/market</td>
<td>119 (1.9)</td>
<td>4 (3.3)</td>
<td>7 (5.8)</td>
<td>2 (1.7)</td>
</tr>
<tr>
<td>Market shop/stall</td>
<td>15 (0.2)</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Sandwich bar</td>
<td>106 (1.7)</td>
<td>3 (2.8)</td>
<td>12 (11.3)</td>
<td>6 (5.7)</td>
</tr>
<tr>
<td>Supermarket delicatessen</td>
<td>203 (3.2)</td>
<td>0</td>
<td>6 (3.0)</td>
<td>2 (1.0)</td>
</tr>
<tr>
<td>Supermarket pre-packed</td>
<td>3820 (60.7)</td>
<td>13 (0.3)</td>
<td>134 (3.5)</td>
<td>55 (1.4)</td>
</tr>
<tr>
<td>Other (Service station, cash &amp; carry, greengrocer, village shop)</td>
<td>147 (2.3)</td>
<td>1 (0.7)</td>
<td>5 (3.4)</td>
<td>2 (1.4)</td>
</tr>
</tbody>
</table>

HPA/LACORS May 2006-April 2007: 6,964 foods
Example structure of food distribution channels
## Probable & Possible Listeriosis cases/clusters (England, Wales: 1999-2011)

<table>
<thead>
<tr>
<th>Year</th>
<th>Region</th>
<th>Cases</th>
<th>Vehicle</th>
</tr>
</thead>
<tbody>
<tr>
<td>1999</td>
<td>NE England</td>
<td>4</td>
<td>Hospital sandwiches</td>
</tr>
<tr>
<td>2003</td>
<td>NE England</td>
<td>17</td>
<td>Butter</td>
</tr>
<tr>
<td>2003</td>
<td>NE England</td>
<td>18</td>
<td>None identified</td>
</tr>
<tr>
<td>2003</td>
<td>S Wales</td>
<td>2</td>
<td>Hospital sandwiches</td>
</tr>
<tr>
<td>2003</td>
<td>SW England</td>
<td>5</td>
<td>Hospital sandwiches</td>
</tr>
<tr>
<td>2004</td>
<td>E Mids</td>
<td>6</td>
<td>None identified</td>
</tr>
<tr>
<td>2004</td>
<td>SE England</td>
<td>2</td>
<td>Hospital sandwiches</td>
</tr>
<tr>
<td>2005</td>
<td>NW England</td>
<td>1</td>
<td>Sliced meat</td>
</tr>
<tr>
<td>2006</td>
<td>London</td>
<td>1</td>
<td>Sliced meat</td>
</tr>
<tr>
<td>2007</td>
<td>London</td>
<td>1</td>
<td>Hospital sandwiches</td>
</tr>
<tr>
<td>2011</td>
<td>Staffordshire</td>
<td>3</td>
<td>Hospital sandwiches</td>
</tr>
</tbody>
</table>

ACM 847a (ACMSF) 2007, Eurosurveillance 16 (20) May 2011
What Makes Chilled Food RTE?

**Controls at manufacture:**
- Manufacturer’s risk assessment and product design, i.e. HACCP plan
  - Supply QA and audits – raw materials
- Appropriate controls
  - Minimise potential for contamination by zoonotic organisms
  - CFA's Micro Guidance for Growers [produce]
  - CFA Best Practice Guidelines for the Production of Chilled Food
- Hygienic preparation and packing – High Care and High Risk Areas
  - Prevent re-/cross-contamination
- Specified thermal processes followed by rapid chilling
  - Equiv. to min. 70°C/2 mins – <10d shelf life
  - Equiv. to min. 90°C/10 mins – >10d shelf life
- Limited shelf life
  - Ensure peak quality
  - Minimise opportunity for microbial growth
What Makes Chilled Food RTE?

Post-Manufacture Controls

- Chilled distribution, sale and storage
  - Minimise potential for microbial growth

- Despatch and distribution to retail
  - <5°C required and monitored by UK major retailers

- Retail storage
  - <8°C legally

- Consumer storage
  - Use by date
  - Usage instructions
Segregation –
GMP/LRA, High Care and High Risk Areas

- **GMP/Low Risk Area**
  - Raw material intake
  - Ready to cook foods
  - Packaged product

- **High Care Area**
  - RTE and ready to reheat food production
  - Includes non-thermally processed ingredients having been through a decontamination process
  - Separate equipment, utensils, staff and changing areas

- **High Risk Area**
  - RTE and ready to reheat food production
  - Only thermally processed foods (minimum 70°C/2 mins)
  - Separate equipment, utensils, staff and changing areas
Which _Lm_ Criterion?

<table>
<thead>
<tr>
<th>Question</th>
<th>YES/NO Outcome</th>
</tr>
</thead>
<tbody>
<tr>
<td>Is product RTE?</td>
<td>No specific <em>Lm</em> criterion applies</td>
</tr>
<tr>
<td>↓ YES</td>
<td></td>
</tr>
<tr>
<td>Is product intended for infants/special medical purposes?</td>
<td><em>Lm</em> absent</td>
</tr>
<tr>
<td>↓ NO</td>
<td></td>
</tr>
<tr>
<td>Is product excluded in a footnote?</td>
<td>No specific <em>Lm</em> criterion applies*</td>
</tr>
<tr>
<td>↓ NO</td>
<td></td>
</tr>
<tr>
<td>Is pH ≤ 4.4 or a_w ≤ 0.92 or pH ≤ 5.0 &amp; a_w ≤ 0.94 or shelf life &lt;5d or frozen at ≤-12°C?</td>
<td>Product unable to support <em>Lm</em> growth. Limit of 100 cfu/g applies</td>
</tr>
<tr>
<td>↓ NO</td>
<td></td>
</tr>
<tr>
<td>Do scientific/modelling/historic/etc data show growth not supported within shelf life?</td>
<td>Limit of 100 cfu/g applies</td>
</tr>
<tr>
<td>↓ NO</td>
<td></td>
</tr>
<tr>
<td>Will low levels of <em>Lm</em>, if present, grow to &gt;100 cfu/g within shelf life under expected storage conditions?</td>
<td>Reduce shelf life so that limit of 100 cfu/g not exceeded during shelf life</td>
</tr>
<tr>
<td>↓ NO</td>
<td></td>
</tr>
<tr>
<td><strong>Shelf life is appropriate</strong></td>
<td></td>
</tr>
</tbody>
</table>

*default is 100/g in RTE food*
What do manufacturers have to do?

• Implement GMP & HACCP
  - EU hygiene 852/2004 etc

• Sample for HACCP verification and monitoring, compositing across lots

• Carry out environmental swabbing:
  - *Lm* (RTE food) – *Listeria* spp as indicator

• Set appropriate shelf life
Shelf life is...

- A critical parameter

- The period of time for which a product remains safe and meets its quality specifications under expected storage and use conditions.
  - Shelf life determines the durability date.

- Setting appropriate shelf life is part of HACCP and required by law

- Very short by design for UK chilled prepared foods
Comparing chilled foods’ shelf lives

<table>
<thead>
<tr>
<th></th>
<th>UK</th>
<th>Other EU</th>
<th>USA</th>
</tr>
</thead>
<tbody>
<tr>
<td>Delicatessen meat</td>
<td>10-15 d (uncured) 15-&gt;30 d (cured)</td>
<td>14-28 d(uncured) 14-56 d(cured)</td>
<td>28-84 d</td>
</tr>
<tr>
<td></td>
<td>[major retailers]</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Sandwiches</td>
<td>2 d [major retailers]</td>
<td>&lt;14* d</td>
<td>&lt; 21 d</td>
</tr>
<tr>
<td></td>
<td>4 d [airline]</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>10 d [discounter]</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Cold-smoked salmon</td>
<td>21-24 d</td>
<td>&lt;120 d</td>
<td>&lt;120 d</td>
</tr>
<tr>
<td></td>
<td>[major retailers]</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Fundamentally the same food so why such different shelf lives?

Answer: Shelf life protocol variability, lack of shelf life validation + reacting to commercial demands
Lm and RTE Shelf Life Assessment

Approach hierarchy:

- **Scientific** (e.g. pH, $a_w$, literature)
  - Won’t support growth, growth reported to be limited
- **Historical or other data**
  - Levels found in reality, i.e. when HACCP functioning (DOP, EOL)
  - Safety record of the product
- **Model outputs** (e.g. ComBase, Growth Predictor)
  - Won’t support growth, growth reported to be limited with the given shelf life under expected storage conditions
- **Shared industry data** on any of the above

- **If none of this available then consider shelf life or challenge test studies**
**Lm Challenge Testing**

- **No legal requirement to do this**
  - If there are GMP, HACCP + supporting systems and the shelf life approach is followed it is not expected to challenge test

- **Disadvantages of challenge testing:**
  - Neither quick nor simple
  - Does not reflect either actual contamination levels nor the physical state of organisms which may be expected to be present
  - Relates only to that specific product formulation/process combination

The safety/stability of a product should instead be satisfactorily addressed during new product development i.e. use HACCP in NPD
Historical Data

• Best indication of an organism’s behaviour in a foodstuff in reality

• When present, *Lm* is from the environment, e.g.
  – in a factory natural contaminants are likely to be stressed and will grow slower than those that have been grown for use in inoculation studies, i.e. in predictive models, challenge testing

• Data on *Lm* levels present at the beginning and at the end of shelf life can be used to assess growth potential

• Manufacturers should have a database for *Lm* consisting of appropriate samples taken at the beginning (DOP) and end of life (EOL) for each RTE product
Durability Studies

• Design safety into the product during NPD!
• Number of studies is determined by HACCP
• Assess
  - Micro safety and stability: indicators + spoilage orgs
  - Organoleptic characteristics, e.g. texture, colour
  - Pathogens before factory trialling
• Test using competent laboratory:
  - Day of production (DOP)
  - End of life (EOL)
  - In-between (if shelf life long enough)
  - Use a different sample for each test point
• Ongoing monitoring
CFA/BRC Shelf Life Guidance

• Consortium of organisations inc FSA, CIEH, LGR

• Contents
  - Who Needs to Use This Guidance?
  - Requirements for the Safe Manufacture of RTE Food
  - Establishing Shelf Life
  - Practical Application of Shelf Life Studies
  - Checklist for Buying Ingredients
  - Questions and Answers
  - Glossary
  - Further Sources of Information
  - Worked Examples Weblinks

• Free download:
  http://preview.tinyurl.com/ycyydy
CFA/BRC/FSA Shelf Life Guidance – Key Points

Ensure that requirements for safe manufacture of RTE foods are in place. See section 5.

If buying RTE ingredients ensure they comply with this guidance. Buy from a reputable source. Obey usage and storage instructions provided, in particular the UBD. See 'Checklist for buyers’ if in doubt. See section 8

If buying ingredients that are not RTE, ensure they are processed to make them RTE, e.g. cooked then cooled. See section 8.

Do the final product’s characteristics control or prevent the growth of Lm or is shelf life <5d? See section 6i.

Assume the food will support the growth of Lm. Do you have evidence 100 cfu/g will not be exceeded during the proposed shelf life? See section 6.

Limit of 100 cfu/g applies throughout shelf life

Demonstrate that the food does not contain Lm at the end of manufacture
Example Use of *Lm* Historical Data

If *Lm* detected in a RTE product:

- at the beginning of shelf life at a level of e.g. <20 cfu/g, and
- data on a representative sample from the same batch at end of life shows levels remain below 100 cfu/g

Then...

- the data help demonstrate that the product remains within the *Lm* criteria over its shelf life
- Under such circumstances, a low level (e.g. <20 cfu/g) detection during shelf life should not need to be withdrawn
CFA/BRC Shelf Life Guidance – Worked Examples

• Data to support shelf life must be documented

• No requirement for data to be held in the format as set out

• Worked examples
  - New Product
    - Cold Smoked Salmon & Fresh Watercress Sandwich – Simplified
    - Cold Smoked Salmon & Fresh Watercress Sandwich – Technical
  - Altering an existing recipe
    - Brie with Garlic and Herbs – Simplified
    - Brie with Garlic and Herbs – Technical
  - Justifying the shelf life of an existing product
    - Cold Smoked Salmon and Fresh Watercress Sandwich
Efficacy of Controls - Industry Data

• Unique, substantial database
  – Data likely to be biased towards best performers
• High volumes of verification analysis by CFA members
  – >382k food samples [2003-10]
  – >326k factory swabs [2006-10]
• DOP (Day of Production)
  – Manufacturing hygiene
• EOL (End of Life)
  – Shelf life appropriateness
• Demonstrates
  – Low isolation frequency and low levels, even at EOL
  – Better control than shown in wider surveys, e.g. HPA, EU
  – Shelf lives are appropriate
  – Implementing current legal & best practice approach works
Conclusions & What We Want

- Applying GMP + HACCP, i.e. High Care/Risk Area regimes, are a **demonstrably effective** control strategy.
- DOP and EOL analysis **works** as a means of demonstrating manufacturing control and shelf life appropriateness.
- **Current rules and guidance need to be implemented and enforced**
  - Hygiene legislation
  - Shelf life establishment
  - Micro Criteria for Foodstuffs
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
  – 20% discount code for EHPs: ‘CFA’

• CFA Lm Management Guidance:
  – Best hygiene practice, methodology, implementation
  – Hard copy available from CFA by request

• Microbiological testing - application & interpretation:
  – http://preview.tinyurl.com/ybo2p35

• EU Microbiological Criteria Regulation 2073/2005:
  – CFA/BRC guidance: http://preview.tinyurl.com/yaxr9ss
  – CFA/BRC Lm and shelf life guidance + worked examples:
    http://preview.tinyurl.com/ycyyyd
The centre of excellence for the chilled food industry

www.chilledfood.org