Failed Hygiene = Failed Food Safety Standards

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Chilled Food Association

SOFHT 14/2/23
Chilled Food Association

Our Mission
To promote and defend the reputation, sustainability 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.

Our Activities

Safety
- Monitoring and benchmarking micro & health and safety data
- Sharing best practice
- Incidents resolution

Research
- Priorities
- Monitoring
- Reporting
- Commissioning

Standards
- Statutory
- International trade
- Commercial
- CFA Guidance

CFA Aims
- Energy
- Waste
- Water
- Ethics

Teacher support
- Lesson plans and consumables
- Training
- Careers information

Our Membership
- Chilled food manufacturers
- Compliant with CFA Guidelines and have BRCGS or IFS certification
- Non-compliances + close-outs
- Resumé of person responsible for food safety
- Reference from existing member

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

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

*Legal max England, Wales, N Ireland
Reducing Costs – Potential Options

1. Reduce energy use per kg food
2. Reduce water use/kg food
3. Cheaper raw materials
4. Clean less thoroughly or change biocide
5. Reduce food lost through waste
6. Increase production efficiency – reduce lost time
7. Change final product packaging/process

But what are the potential negative consequences you must fully consider and effectively address?
What Makes Food RTE?

• Manufacturer’s risk assessment & product design, i.e. HACCP plan:

• Appropriate (growing &) production controls – validation + monitoring
  • Minimise potential for contamination by zoonotic organisms

• Hygienic preparation and packing – validation + monitoring
  • Prevent re-/cross-contamination
  • (thermal) Process

• Limited shelf life - UK chilled prep food shelf lives 1/3 to ½ of usual Continental
  • Ensure peak quality
  • Minimise opportunity for microbial growth

• Chilled distribution, sale and storage - UK chill: 5°C max to RDCs required commercially
  • Minimise potential for microbial growth - domestic fridges ~7°C (FSA project B13006)

• Appropriate usage instructions
  • E.g. Chilled storage
  • Durability date – ‘use by’ for chilled, ‘best before’ otherwise
  • No further process to reduce/eliminate hazard microorganisms
Translates to: Fundamental Food Safety Rules

• The 4Cs:

  • **Clean**: remove soil and protein before applying surface biocide, decontaminate produce
  
  • **Cook**: 70°C/2 mins or 90°C/10 or 121°C/3 or SUSSLE?
  
  • **Avoid Cross-Contamination**: segregate
  
  • **Cold**: prevent non-proteolytic *C. botulinum* toxin production and *B. cereus* growth, reduce growth rate of *L. monocytogenes* (cf 5°C: 8°C 2x rate, 10°C 3x)

• 5\text{th} rule:

  • Use good quality raw materials/ingredients – **vital for raw/minimally processed**
Listeriosis

- The commonest cause of foodborne illness-related death in Europe (but not UK)
  - *UK estimate: NoV 56, Salmonella 33, Lm 26, C perfringens 21, Campylobacter 21
- ‘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: 3-90 days (source ID?)
- Long term sequelae**: seizures, paralysis, impaired ability to see, hear or speak

* Estimating deaths from foodborne disease in the UK for 11 key pathogens, (2020) [https://bmjopengastro.bmj.com/content/7/1/e000377](https://bmjopengastro.bmj.com/content/7/1/e000377)

** [https://www.canr.msu.edu/news/the_serious_and_long-term_effects_of_foodborne_illness](https://www.canr.msu.edu/news/the_serious_and_long-term_effects_of_foodborne_illness)
Listeria monocytogenes (Lm)

- One of 26 Listeria species - **Lm is the only species legislated for**: human pathogen
- Widespread in environment: soil, water, animal faeces, vegetation
- Carried by ~10% of people
- Long incubation period: up to 90 days before symptoms appear
- Grows at refrigerator temperatures (-2°C)*
- Survives freezing (-18°C)
- Relatively heat resistant (70°C/2 mins for 6-log reduction)
- Grows in low O₂ environments, e.g. vacuum packed foods
- Highly salt tolerant (Aₜ 0.92): survives in >20% salt solution, and grows even in cured foods
- Min pH for growth 4.2-4.3
- **Forms persistent biofilms on surfaces**
  - Resistant to cleaning and disinfection
  - Creates reservoir of contamination
  - Must enforce rigorous hygiene schedules to manage
- Vulnerable groups are particularly susceptible
- Transmission from infected food, the environment, mother to foetus
- **Main cause of death from foodborne illness in the EU**

* EU Lm Reference Lab
Vulnerable Groups

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

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

• Proportion of population in a vulnerable group?
  • USA** and UK *** ~ 20%

*** The Occurrence and Prevention of Foodborne Disease in Vulnerable People. Foodborne Paths & Disease. 2011; 8 (9), 961-973
## 2021 EU27+EEA+EFTA Top 5 Foodborne Diseases Morbidity & Mortality

### Disease

<table>
<thead>
<tr>
<th>Disease</th>
<th>No. confirmed human cases</th>
<th>Status available (%)</th>
<th>Number of reporting countries</th>
<th>Reported hospitalised cases</th>
<th>Proportion hospitalised (%)</th>
<th>Outcome available (%)</th>
<th>No. reporting MS</th>
<th>Reported Deaths</th>
<th>Case Fatality (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Campylobacteriosis</td>
<td>127,840</td>
<td>45,121</td>
<td>35.3</td>
<td>15</td>
<td>10,469</td>
<td>71.3</td>
<td>16</td>
<td>26</td>
<td>0.03</td>
</tr>
<tr>
<td>Salmonellosis</td>
<td>60,050</td>
<td>30,951</td>
<td>51.5</td>
<td>16</td>
<td>11,785</td>
<td>64.4</td>
<td>16</td>
<td>71</td>
<td>0.18</td>
</tr>
<tr>
<td>Yersiniosis</td>
<td>6,789</td>
<td>1,564</td>
<td>23.0</td>
<td>13</td>
<td>508</td>
<td>53.0</td>
<td>21</td>
<td>0</td>
<td>0.00</td>
</tr>
<tr>
<td>STEC infections</td>
<td>6,084</td>
<td>2,133</td>
<td>35.1</td>
<td>17</td>
<td>901</td>
<td>71.8</td>
<td>20</td>
<td>18</td>
<td>0.41</td>
</tr>
<tr>
<td>Listeriosis</td>
<td>2,183</td>
<td>956</td>
<td>43.8</td>
<td>16</td>
<td>923</td>
<td>65.4</td>
<td>14</td>
<td>196</td>
<td>13.7</td>
</tr>
</tbody>
</table>

* 2020: Listeriosis death rate 260x Campylobacteriosis, 31x STEC
** 2019: Listeriosis death rate 586x Campylobacteriosis, 84x STEC
*** 2018: Listeriosis death rate 520x Campylobacteriosis, 71x STEC
**** 2017: Listeriosis death rate 345x Campylobacteriosis, 28x STEC
***** 2016: Listeriosis death rate 540x Campylobacteriosis, 60x STEC

EXCLUDES UK

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† Not all countries observed cases for all diseases
Reducing Costs – Options and Issues

1. Reduce energy use per kg food
   - Thermal processing: validated processes required to reduce pathogens + spoilage organisms
   - Cooling: risk of bacterial growth if not rapid enough (e.g., *B. cereus*)
   - Cleaning: risk of contamination leading to biofilms, risk of not identifying issues if reduce ongoing sampling of food and environment and timely effective action to address issues
   - Transportation including product conveyors

2. Reduce water use/kg food
   - Recycling and reuse – validated treatments to prevent contamination of plant and/or food including in the field – GAP standards must be adhered to particularly for raw RTE crops
   - Food contact/ingredient/non-food contact (note aerosols → food/environmental contamination)
Reducing Costs – Options and Issues

3. Cheaper raw materials
   • Change sourcing (traceability/provenance/risk), fresh produce damage increases micro risk

4. Clean less thoroughly or change biocide

5. Reduce Food lost through waste
   • Work in progress (WIP)/final product: extend shelf life to increase usability
     • Thermal process, deep chill, HPP, phage, formulation, other?

6. Increase production efficiency – reduce lost time
   • Reduce number of changeovers – longer runs (needs longer shelf life?)
   • Increase volumes per batch – need to store WIP, final product (costs energy and space)

7. Final Product
   • Packaging technology – materials (sustainability?), introduces new risks (eg low O₂)
   • Post-pack process, eg duo pasteurisation – quality impact, other?
In biofilms, metabolism and behaviour of bacteria is different from individual organisms in a culture broth.

Robust hygiene systems: Clean - Disinfect - Verify - Repeat

- Lm enters a factory (e.g. raw materials, staff)
- Drains = hotspot unless take special measures
- Spreads onto equipment, persists
- Persistent strains mostly isolated from final products
- Lm can adhere to equipment commonly and form biofilms

Multi-species biofilms: how to avoid unfriendly neighbors. Rendueles & Ghigo: http://dx.doi.org/10.1111/j.1574-6976.2012.00328.x 972-989
### Efficacy of sanitisers vs. *Lm* on poorly & properly cleaned *Lm*-inoculated surfaces or suspensions

<table>
<thead>
<tr>
<th>Sanitiser type</th>
<th>In absence of protein residues (effective cleaning)</th>
<th>In presence of protein residues (poor cleaning)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>No. studies reviewed</td>
<td>No. observations</td>
</tr>
<tr>
<td>Halogen</td>
<td>3</td>
<td>27</td>
</tr>
<tr>
<td>Hypochlorite</td>
<td>11</td>
<td>321</td>
</tr>
<tr>
<td>Peracetic acid</td>
<td>6</td>
<td>177</td>
</tr>
<tr>
<td>Quaternary ammonium</td>
<td>5</td>
<td>59</td>
</tr>
</tbody>
</table>

Presence of protein greatly reduces efficacy of biocides, wasting money

What Good Control Looks Like: 2010-2021
CFA UK Chilled Food Industry Lm Data

- RTE food prevalence (1,008,614 samples):
  - <0.7% Lm at any point during shelf life, of which
  - <0.01% present at quantifiable levels, i.e. >20 cfu/g LOQ (note 10 cfu/g is common LOQ)

- Production environment prevalence (1,851,301 samples during production + post hygiene):
  - Food contact surfaces ~0.3% Lm (~914k samples)
  - Non-Food contact surfaces ~2.3% Lm (~937k samples)

- Gives a high level of public health protection (EFSA/ECDC/UKHSA data):

<table>
<thead>
<tr>
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<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Europe inc UK</td>
<td>0.37</td>
<td>0.33</td>
<td>0.41</td>
<td>0.44</td>
<td>0.52</td>
<td>0.46</td>
<td>0.48</td>
<td>0.48</td>
<td>0.47</td>
<td>0.46</td>
<td></td>
<td></td>
</tr>
<tr>
<td>UK</td>
<td>0.28</td>
<td>0.26</td>
<td>0.29</td>
<td>0.30</td>
<td>0.31</td>
<td>0.29</td>
<td>0.31</td>
<td>0.24</td>
<td>0.25</td>
<td>0.23</td>
<td>0.22</td>
<td></td>
</tr>
<tr>
<td>Europe exc UK</td>
<td>0.39</td>
<td>0.34</td>
<td>0.43</td>
<td>0.46</td>
<td>0.56</td>
<td>0.49</td>
<td>0.50</td>
<td>0.50</td>
<td>0.49</td>
<td>0.42</td>
<td>0.49</td>
<td></td>
</tr>
</tbody>
</table>
## Examples of Major Fatal Listeriosis Outbreaks & Root Causes

<table>
<thead>
<tr>
<th>Country (year)</th>
<th>Outcomes and Root Causes</th>
</tr>
</thead>
<tbody>
<tr>
<td>UK (1987-9)</td>
<td>&gt;17 dead, 200+ cases. Pâté imported from Belgium. <strong>Post-process hygiene</strong></td>
</tr>
<tr>
<td>USA (1998-9)</td>
<td>17 dead, 4 miscarriages/stillbirths, 101 cases. Cooked meat. <strong>Contamination from air filtration unit maintenance.</strong></td>
</tr>
<tr>
<td>Canada (2008)</td>
<td>22 dead, 57 cases. CAD 27m. Cooked sliced meat. Dirty slicer. <strong>Post-process hygiene</strong></td>
</tr>
<tr>
<td>Denmark (2014)</td>
<td>17 dead, 41 cases. Cooked meat (rullepølse). <strong>Post-process contamination</strong></td>
</tr>
<tr>
<td>South Africa (2017-18)</td>
<td>216 dead, 1060 cases. Cooked RTE meat products. <strong>Post-process contamination</strong></td>
</tr>
<tr>
<td>Netherlands, Belgium (2017-19)</td>
<td>3 dead, 21 cases. Cooked meat product. <strong>Post-process contamination</strong></td>
</tr>
<tr>
<td>Spain (2019)</td>
<td>3 dead, 7 miscarriages, 200+ cases. Cooked meat product. <strong>Post-process contamination</strong></td>
</tr>
</tbody>
</table>

**Also:** EU frozen sweetcorn (2015-18) – not produced to RTE (High Care) standards but consumed uncooked by some
2017-18 South African Listeriosis Outbreak: RTE Meat Product

- The largest Listeriosis outbreak ever recorded
- Reported cases up until Sept 2018
  - 1060 laboratory confirmed cases
  - 216 confirmed dead
- Before 2017:
  - 60 to 80 a year reported

![Graph showing epidemic curve of laboratory-confirmed listeriosis cases by date of clinical specimen collection, South Africa, 01 January 2017 to 20 June 2018 (n=1053).](image)
South Africa: Fatal Listeriosis

Factors contributing to outbreak severity
- ST6 hypervirulent strain
- Contamination post-process
- Long shelf life

Widely consumed staple food
- Many groups vulnerable
- Pregnant women and their children
- Reporting issues

S. Africa Says Processed Meat Demand Dropped 75% on Listeriosis

Eff to launch class action suit over #Listeriosis crisis

Tiger brands could pay out R425m to Listeriosis victims

When the impact of the listeriosis outbreak is eventually analysed, it’s quite possible that the township economy will be mentioned only as a footnote in official reports. Even though the actual cause of the deadly outbreak was discovered when children were admitted to Chris Hani Baragwanath Hospital, located in South Africa’s biggest township, Soveto, the actual source of the bacterial epidemic was traced to a factory in Polokwane, in Limpopo, that is owned by Tiger Brands.

The link between the outbreak and the Tiger Brands factory was announced by Health Minister Dr Aaron Motsoaledi in February. Before that announcement, there was a lot of optimism for the township economy. Earlier in the month, Gauteng Premier David Makhura had, for the third time, promised that the
A class action suit has been launched against Tiger Brands [JSE:TBS] and Enterprise Foods at the Johannesburg High Court.

The group of ten applicants seeks declaratory relief as follows:

* Those who contracted Listeriosis.

* Those who (in utero) contracted but did not die as a result of Listeriosis as a result of their mothers ingesting food products originating from or having passed through the Enterprise meat processing facility at Polokwane.

* Those who were dependent upon persons who died from Listeriosis.

* Those who were dependent upon persons who died as a consequence of contracting the disease.

The Enterprise factory in Germiston, east of Johannesburg is seen. (News24)
South African RTE Meat Products: End Points

• Contaminated high risk long shelf life chilled food eaten as a staple in a country with a 20% HIV positive adult population – and exported

• All 157 processed meat factories inspected
  • By WHO and environmental health inspectors

• 900 health inspectors retrained
  • In taking samples from food factories

• New SA legislation (R638) brought in 14 June 2018
  • Requires HACCP/FSMS for meat and poultry products & Lm Not Detected

• 2 years on:

  Tiger Brands just sold its listeriosis polony factory – but stays on the hook for damages
Europe: Fatal Listeriosis (2015-18) linked to frozen corn

- ST6 is ‘hypervirulent’
- Traceability info for the frozen corn samples pointed to products packed in Poland, processed/produced in Hungary
- Risk management recommendation: ‘consumers should consider adequately heat treating frozen vegetable products that are not ‘RTE products’ before consumption’

Table 1. *Listeria monocytogenes* IVb, ST6 confirmed outbreak cases by country and year, EU 2015–2018 (as of 15 June 2018)

<table>
<thead>
<tr>
<th>Country</th>
<th>2015</th>
<th>2016</th>
<th>2017</th>
<th>2018</th>
<th>Total cases</th>
<th>Total deaths</th>
</tr>
</thead>
<tbody>
<tr>
<td>Austria</td>
<td>0</td>
<td>2 (1)</td>
<td>0</td>
<td>0</td>
<td>2</td>
<td>1</td>
</tr>
<tr>
<td>Denmark</td>
<td>0</td>
<td>0</td>
<td>2</td>
<td>2 (1)</td>
<td>4</td>
<td>1</td>
</tr>
<tr>
<td>Finland</td>
<td>0</td>
<td>4</td>
<td>10 (2)</td>
<td>9</td>
<td>23</td>
<td>2</td>
</tr>
<tr>
<td>Sweden</td>
<td>0</td>
<td>3 (1)</td>
<td>3 (1)</td>
<td>1 (1)</td>
<td>7</td>
<td>3</td>
</tr>
<tr>
<td>United Kingdom</td>
<td>1</td>
<td>2</td>
<td>2 (2)</td>
<td>6</td>
<td>11</td>
<td>2</td>
</tr>
<tr>
<td>Total</td>
<td>1 (0)</td>
<td>11 (2)</td>
<td>17 (5)</td>
<td>18 (2)</td>
<td>47</td>
<td>9</td>
</tr>
</tbody>
</table>

France, Germany, Ireland, Italy Luxembourg, the Netherlands, Norway and Portugal report no human isolates matching the European outbreak strain.

Figure 1. *Listeria monocytogenes* PCR serogroup IVb, ST6 confirmed outbreak cases by month of symptom onset*, European Union 2015–2018 (n=47)
EU Ready To Cook Frozen Maize: Key Points

• Frozen maize
  • High sugar, cut surface: supports growth of *Listeria monocytogenes*
  • Blanching typically 90°C/90 secs – deals with surface contamination – core?
  • Post-process recontamination potential
  • ...But not RTE, so ‘low risk’, and no limits apply by (EU) law, and not treated as a High Care food from field to processing

• *EFSA risk management recommendation:
  “consumers should consider adequately heat treating frozen vegetable products that are not ‘RTE products’ before consumption”

Improved cleaning programmes: belts removed every time kit is cleaned

Handover area between higher care and lower care area. Fork lift 1 drives bin in to square, second takes out and off to storage

Scrubber dryer dries floors of excess water

New boot wash and hand sanitiser station on entrance to zoned area
EU RTC Frozen Maize: End Points

- Hygiene and sampling – investments and new systems
  - Equipment (freezer tunnel) decommissioned/replaced (conveyors, flooring) - capex
  - Systems reviewed and improved - capex
    - New zoning approaches implemented: Separation between pre- and post-blanch areas
    - Sanitation improved with new monitoring
  - Post-hygiene environment swabbing for Lm now routine
  - In-process and final product sampling for Lm now routine (previously *E. coli*)
  - Product sampling dependent on customer requirements
    - e.g. 1-5 samples end product tested/batch
- Profel (European federation)
  - suggesting <10 cfu/g on RTC frozen?
  - challenge test studies and usage labelling recommendations based on growth potential
- Company applying <10 cfu/g criterion on imports into UK
# Effective Risk Management?

<table>
<thead>
<tr>
<th>Lm management demonstrably in place?</th>
<th>SA RTE cooked meat products</th>
<th>EU frozen maize</th>
</tr>
</thead>
<tbody>
<tr>
<td>Manufacturing hygiene managed to prevent (re)contamination</td>
<td>False</td>
<td>False</td>
</tr>
<tr>
<td>Product does not support growth</td>
<td>False</td>
<td>False</td>
</tr>
<tr>
<td>Product does not support survival</td>
<td>False</td>
<td>False</td>
</tr>
<tr>
<td>Not a chilled product</td>
<td>False</td>
<td>True</td>
</tr>
<tr>
<td>Short shelf life (&lt;5 days)</td>
<td>False</td>
<td>False</td>
</tr>
<tr>
<td>Chill chain integrity assured</td>
<td>?</td>
<td>True</td>
</tr>
<tr>
<td>- Commercial</td>
<td>?</td>
<td>True</td>
</tr>
<tr>
<td>- Domestic</td>
<td>?</td>
<td>True</td>
</tr>
<tr>
<td>Consumer population/behaviour</td>
<td></td>
<td></td>
</tr>
<tr>
<td>- Not eaten by vulnerable groups</td>
<td>False</td>
<td>?</td>
</tr>
<tr>
<td>- Usage instructions complied with</td>
<td>?</td>
<td>False</td>
</tr>
<tr>
<td><strong>Total (T =+1, F =-1, ?=0) out of +9 max</strong></td>
<td>-6</td>
<td>-2</td>
</tr>
</tbody>
</table>
Summary

• Compromise hygiene or any of the 4Cs at your peril
• Short term decisions can have life-changing long term consequences:
  • For consumers of your food
  • For your business
  • For you
• Are your HACCP plans, sanitation and monitoring systems consistently effective?
• Is legislation a barrier to effective monitoring?
• Why are previous lessons not being cascaded more effectively?
  • Within industry – trade associations/professional bodies?
  • By and to customers (e.g. manufacturers, retailers)
• REPEAT: Compromise hygiene or any of the 4Cs at your peril
# Listeria-related Guidance Available

<table>
<thead>
<tr>
<th>Author</th>
<th>Year</th>
<th>Title</th>
<th>Web link</th>
</tr>
</thead>
</table>
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www.chilledfood.org

www.chillededucation.org

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