Microorganisms Causing Foodborne Disease

_Listeria monocytogenes_

Species of _Listeria_

- _L. monocytogenes_
- _L. ivanovii_
- _L. innocua_
- _L. welshimeri_
- _L. seeligeri_
- _L. grayi_
- _L. murrayi_

Biochemical and morphological characteristics

- Gram-positive
- Small cocobacilli
- Motile at 20-25°C – Stumbling motility
- Non-sporeformer
- Microaerobic

<table>
<thead>
<tr>
<th>Factor</th>
<th>Growth range</th>
</tr>
</thead>
<tbody>
<tr>
<td>Temperature</td>
<td>2.5 – 42°C</td>
</tr>
<tr>
<td>pH</td>
<td>5.6 – 9.8</td>
</tr>
</tbody>
</table>
Habitat - plants

- Maize
- Soybeans
- Shrubs
- Bush leaves
- Silage

Habitat - animals

- 15 animal species
- Humans
- Amphibian, fish, insects
  - Frogs, various fish, crustaceans, ticks, ants
- 16 avian species
  - Wild, captive, edible

Clinical variants of human listeriosis

- Pregnant women and newborns
- Meningitis and meningoencephalitis
- Cutaneous
- Septicemic
  - Sore throat and mononucleosis
- Septic pneumonic granulomatosis
- Lymphogen (cervicoglandular)
- Less common forms
  - Arthritis, peritonitis, osteomyelitis, cerebral abscess
Commonly associated foods

- Soft cheese
  - Short ripening time, high pH (>5.0)
- "Pasteurized" milk
- Coleslaw
- Alfalfa (tablets)
- Fresh vegetables
- Frankfurters

Prevalence in foods

<table>
<thead>
<tr>
<th>Food</th>
<th>% positives</th>
<th>Country</th>
</tr>
</thead>
<tbody>
<tr>
<td>Milk</td>
<td>0-0.7</td>
<td>U.S.A.</td>
</tr>
<tr>
<td>Milk</td>
<td>0.0</td>
<td>Mexico</td>
</tr>
<tr>
<td>&quot;Pasteurized&quot; milk</td>
<td>21.0</td>
<td>Spain</td>
</tr>
<tr>
<td>Soft cheeses</td>
<td>25.0</td>
<td>Mexico</td>
</tr>
<tr>
<td>Chicken</td>
<td>15.0</td>
<td>UK</td>
</tr>
<tr>
<td>Frozen chicken</td>
<td>57.0</td>
<td>UK</td>
</tr>
<tr>
<td>Sausages</td>
<td>43.0</td>
<td>U.S.A.</td>
</tr>
<tr>
<td>Ground beef</td>
<td>70.0</td>
<td>U.S.A.</td>
</tr>
</tbody>
</table>

Behavior in foods

Growth, survival and resistance
Growth of different strains of *Listeria monocytogenes* in vacuum-packaged ground beef

<table>
<thead>
<tr>
<th>Strain</th>
<th>Serovar</th>
<th>Increase (log$_{10}$) after 35-54 days of refrigerated storage</th>
</tr>
</thead>
<tbody>
<tr>
<td>N-7143</td>
<td>3a</td>
<td>2.3</td>
</tr>
<tr>
<td>Na-19</td>
<td>3b</td>
<td>1.8</td>
</tr>
<tr>
<td>Na-16</td>
<td>1/2a</td>
<td>0.0</td>
</tr>
<tr>
<td>Scott A</td>
<td>4b</td>
<td>-1.3</td>
</tr>
</tbody>
</table>


*L. monocytogenes* grew in aerobic atmosphere at 4°C and at 20°C, whereas no growth was observed in 100% CO$_2$ or in the presence of nisin

Fang and Lin. 1994. J. Food & Drug Analysis

Survival of *L. monocytogenes* Scott A on refrigerated (4°C) beef and pork loins

![Graph showing survival of *L. monocytogenes* Scott A on refrigerated beef and pork loins](image)
Behavior of *L. monocytogenes* Scott A, psychrotrophs and lactic acid bacteria on pork loins at 4°C

Heat resistance of *L. monocytogenes* in ground pork with or without soy added

<table>
<thead>
<tr>
<th>Food product</th>
<th>D value (min) at:</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>50°C</td>
</tr>
<tr>
<td>Ground pork</td>
<td>108.8</td>
</tr>
<tr>
<td>Ground pork + textured soy</td>
<td>113.6</td>
</tr>
</tbody>
</table>

Ollinger-Snyder, et al. 1995. J. Food Prot. 58:573

D\textsubscript{55°C} for different bacteria

However *L. monocytogenes* is not thermoduric

- *Streptococcus lactis*: 2 min
- *Pseudomonas aeruginosa*: 2 min
- *Escherichia coli*: 5 min

ICMSF, 1980
### Detection methods

**Enrichment**
- **Refrigerated**
  - Non-selective broth incubated at 7°C for long periods of time (~15 – 30 days)
- **Selective**
  - UVM, LEB (include antibiotics) incubated at 32-35°C for 24-48 h

**Some methods include a secondary enrichment in Fraser broth to discard non-*Listeria* organisms**

**Isolation media**
- McBride, LPM, Oxford, modified Oxford, PALCAM
  - OXPC recently developed by Martinez et al.