Microbiology of primary food commodities

IIa
Processed Meats

Processed meats

• Vacuum or MA packaged meats
• Cured and luncheon meats
  – Examples
    • Ham
    • Bologna
    • Frankfurters
• Smoked meats
  – Examples
    • Bacon
    • Sausage

| Table 5.1. Genera of Bacteria Most Frequently Found on Processed Meats and Poultry |
|-----------------------------------------------|---|---|---|---|
|          | Gram Reaction | Processed Meats | VT Meats | Bacon |
| Acinetobacter  | – | X | X | X |
| Aeromonas    | – | X | – | – |
| Bacillus     | + | X | – | X |
| Brevibacterium | + | X | XX | – |
| Clostridium  | + | X | X | X |
| Enterobacter | X | X | X | X |
| Enterococcus | + | X | XX | X |
| Hafnia       | X | X | – | X |
| Kocuria      | X | X | X | X |
| Leucoctopus  | X | X | XX | – |
| Leuconostoc | X | X | X | – |
| Lactococcus  | X | X | X | X |
| Micrococcus  | X | X | X | X |
| Moraxella    | X | X | – | X |
| Pseudomonas  | X | X | – | X |
| Pediococcus  | X | X | X | X |
| Propionibacterium | X | X | X | X |
| Proteus      | X | X | X | X |
| Weissella    | X | X | X | X |

Note: X = known to occur; XX = most frequently reported.
Sources of microorganisms

- Raw meat
- Spices and other ingredients
- Natural casings

Spoilage

- Slimy spoilage
  - Occurs on the outside of casing
  - Yeasts, lactic acid bacteria, *B. thermosphacta*

- Souring
  - Occurs underneath the casing
  - Due to growth of LAB

- Greening
  - Due to *H₂O₂* production
  - *Lactobacillus*
  - Due to *H₂S* production
  - Reacts with myoglobin to form sulphmyoglobin
  - *Pseudomonas mephitica*
Food safety aspects

- Fully cooked cured meats are not commonly associated with FBI – Listeriosis and frankfurters
- Dry meats (beef jerky) have been associated with FBI – Salmonella
- Fermented sausages have been associated with FBI – *E. coli* O157:H7

Outbreaks associated with beef products

Morbidity and Mortality Weekly Report (CDC)

- *E. coli* O157:H7, 1994, salami, Washington and California; >20 cases, 2 HUS
- *S. montevideo*, 1995, New Mexico; beef jerky; 93 cases


![Graph showing sausage recalls by hazard associated. United States, 1994-1998.](image)
Hot dogs and listeriosis

- Turkey franks were confirmed vehicle of *L. monocytogenes* in 1989.
- Purchasing foods from deli counters was significantly associated with listeriosis (1988-1990)

CDC, 1992

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Hot dogs and listeriosis

- 1998-1999
- Multistate
  - 22 states
- 21 deaths
- Hot dogs and deli meats
- Caused by a rare strain of serotype 4b

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Sources of *L. monocytogenes*

- Raw materials?
  - Franks are fully cooked
- Plant environment?
  - *L. monocytogenes* is widely distributed in the environment
Hot dog process

Salmonella, *E. coli* O157:H7 and sausage

Outbreaks associated with sausage products

**Fresh sausages**
- No kill step during process
- Raw materials are a major source of pathogens

**Dry fermented sausages**
- *E. coli* O157:H7 major concern
- A kill step can be introduced
- Raw materials are a major source of pathogens
USDA-FSIS guidelines

Manufacturers must ensure a 5-log reduction of *E. coli* O157:H7 during manufacture of dry or semidry fermented sausage.

*E. coli* O157:H7 in pepperoni

Faith et al., J. Food Prot. 61:377, 1998

<table>
<thead>
<tr>
<th>% Fat in batter</th>
<th>15% fat</th>
<th>20% fat</th>
<th>32% fat</th>
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<tr>
<td>pH</td>
<td>4.3</td>
<td>4.7</td>
<td>4.9</td>
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</tbody>
</table>

Pepperoni process

Hinkens et al., J. Food Prot. 59:1260, 1996

- Raw, may be contaminated
- Fermentation: 96°F, 85% RH, pH ≤ 5.0
- Drying: 55°F, 65% RH
  - 63°C
  - 53°C/60 min
Survival of *E. coli* O157:H7 in pepperoni after heating treatment
Hinkens et al., J. Food Prot. 59:1260, 1996

Survival of *Salmonella* during drying of chorizo
Escartin et al. 1996

Example of fresh pork sausage
*Chorizo*
Incidence of *Salmonella* in retail chorizo.
Querétaro, Mexico

<table>
<thead>
<tr>
<th>Site of:</th>
<th>Processing</th>
<th>Sampling</th>
<th>No samples</th>
<th>% Positives</th>
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<tbody>
<tr>
<td>Meat plants</td>
<td>Grocery stores</td>
<td>40</td>
<td>5</td>
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<tr>
<td>Butcheries</td>
<td>Butcheries</td>
<td>40</td>
<td>78</td>
<td></td>
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Escartin et al., 1996