Poultry Production and Food Safety: An International Perspective

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Overview

• Salmonellosis in humans
• *Salmonella* surveillance in poultry slaughter plants in U.S. and E.U.
• What can be done to reduce the risk of *Salmonella* in poultry production?
  – Pre-harvest interventions
  – Post-harvest interventions
Incidence of Salmonellosis

- *Salmonella* is a leading cause of foodborne disease worldwide (~94 M cases /year)

<table>
<thead>
<tr>
<th>Country/Region</th>
<th>Salmonellosis incidence per 100,000 population*</th>
</tr>
</thead>
<tbody>
<tr>
<td>USA</td>
<td>17.6</td>
</tr>
<tr>
<td>EU-25</td>
<td>42.2</td>
</tr>
<tr>
<td>-UK</td>
<td>24.3</td>
</tr>
<tr>
<td>-Denmark</td>
<td>28.5</td>
</tr>
<tr>
<td>-Sweden</td>
<td>39.7</td>
</tr>
<tr>
<td>-The Netherlands</td>
<td>9.4</td>
</tr>
<tr>
<td>Australia</td>
<td>43.6</td>
</tr>
<tr>
<td>Japan</td>
<td>32.0</td>
</tr>
<tr>
<td>UAE</td>
<td>?</td>
</tr>
</tbody>
</table>

### U.S.A. Healthy People 2020 Objectives

<table>
<thead>
<tr>
<th>Pathogen</th>
<th>2006-08 incidence</th>
<th>2010 incidence</th>
<th>2020 Objective</th>
</tr>
</thead>
<tbody>
<tr>
<td><em>Campylobacter</em></td>
<td>12.7</td>
<td>13.6</td>
<td>8.5</td>
</tr>
<tr>
<td><em>Escherichia coli</em> O157</td>
<td>1.2</td>
<td>0.9</td>
<td>0.6</td>
</tr>
<tr>
<td><em>Salmonella</em></td>
<td>15.2</td>
<td>17.6</td>
<td>11.4</td>
</tr>
<tr>
<td><em>Listeria monocytogenes</em></td>
<td>0.3</td>
<td>0.3</td>
<td>0.2</td>
</tr>
</tbody>
</table>

Incidence per 100,000 population
Salmonellosis associated with poultry

• 22-29% of human salmonellosis cases have been attributed to poultry consumption in the U.S. (USDA., 2008; Braden, 2006)
  – Based on outbreak and surveillance data
Poultry Production around the World

Rest Of the World 30.6%
China 17%
Brazil 15.4%
EU-27 11.7%
Mexico 3.7%
USA 21.6%

Source: USDA, 2010
Poultry Exporting

- Brazil: 40%
- USA: 36%
- EU-27: 9%
- Thailand: 5%
- China: 3%
- Rest of the World: 7%

Source: USDA, 2010
Poultry Meat **Consumption** (in million tons)  
2004-2008
## Salmonella Prevalence on Raw Chicken Meat

<table>
<thead>
<tr>
<th>Country</th>
<th>% <em>Salmonella</em> Slaughter*</th>
<th>% <em>Salmonella</em> Retail</th>
</tr>
</thead>
<tbody>
<tr>
<td>USA</td>
<td>5.2 (n=3,275)</td>
<td>4.2 (n=212)</td>
</tr>
<tr>
<td>United Kingdom</td>
<td>3.6 (n=401)</td>
<td>4.0 (n=877)</td>
</tr>
<tr>
<td>Sweden</td>
<td>0.3 (n=410)</td>
<td>0.0 (n=40)</td>
</tr>
<tr>
<td>Spain</td>
<td>14.4 (n=389)</td>
<td>35.8 (n=198)</td>
</tr>
<tr>
<td>Belgium</td>
<td>18.7 (n=380)</td>
<td>36.0 (n=772)</td>
</tr>
<tr>
<td>China</td>
<td>-</td>
<td>52.2 (n=1,152)</td>
</tr>
<tr>
<td>Russia</td>
<td>-</td>
<td>31.2 (n=698)</td>
</tr>
<tr>
<td>Vietnam</td>
<td>-</td>
<td>45.9 (n=1,000)</td>
</tr>
<tr>
<td>Colombia</td>
<td>-</td>
<td>27.0 (n=1,003)</td>
</tr>
<tr>
<td>Australia</td>
<td>36.7 (n=408)¥</td>
<td>43.3 (n=859)</td>
</tr>
</tbody>
</table>

*2008, ¥2010
Salmonella Surveillance in Broiler Production in USA

- United States Department of Agriculture-Food Safety and Inspection Service (USDA-FSIS)
  - Inspect poultry slaughter facilities
  - Collect one chicken carcass per day, rinsed, and rinsate sent for Salmonella analysis
  - Carcasses selection continue for 51 days or until 51 carcasses have been tested
  - >5 positives/51 samples; indicate a failure
  - Poultry slaughter plant have 30 days to correct failure
Salmonella Surveillance in Broiler Production in USA

• After 30 days, testing (another 51 days) begins again

• After a second failure, poultry plant must write a detailed plan for corrective action to reduce Salmonella prevalence and prevent recurring

• Testing again begin after 30 days

• A third failure results in closing the slaughter/processing plant (USDA, 1996)
Salmonella Surveillance in Broiler Production in EU

• One day a week, 15 neck skin samples from broiler carcasses (post-chill)

• Pool them into 5 samples (3 neck skin each- 25g per pool) and test for Salmonella

• If positive, improvement in slaughter hygiene and review of process controls, origin of the birds and bio-security measures in the farm of origin, are required
UAE Poultry Production

- Annual chicken meat production: 35,000 MT (20% of UAE market demand)
- Annual import: 146,000 MT
- Six large-sized farms (65%) and four medium-sized farms (20%) accounted for most of the UAE production
- Feed ingredients and chicks (mostly) are imported
- Prevalence of *Salmonella* on raw chicken meat at retail in Dubai 46.7% (n=60)  *Khan et al. (2010)*
• What can be done to reduce the risk of *Salmonella* in poultry production?
  – Pre-harvest interventions
  – Post-harvest interventions
Top-down *Salmonella* control

Preharvest *Salmonella* interventions

- Elites
- GGP
- Grandparents
- Breeders
- Broilers
- Slaughter/Processing
- Consumer

Postharvest *Salmonella* interventions
Potential Sources of *Salmonella*

- Wildlife
- Insects
- Rodents
- Fomites
- Feed
- Water
- Litter
- Hatchery/Bird Move
- Humans
- Vehicles

Source: Dr. Hofacre
Poultry Feed

• **USA:**
  - Feed ingredient source
  - Pest (i.e., Rodent/insect) control
  - Feed decontamination
    • Organic acid (propionic, formic, acetic, and butyric)
    • Formaldehyde

• **EU:**
  - Feed must be *Salmonella*-free.
  - This is achieved through:
    • Import control on raw materials and testing
    • Mandatory heat treatment of compound feeding stuff for poultry
    • HACCP-based *Salmonella* control in the feed industry
Breeders

**USA:**

- Many poultry companies vaccinate for *Salmonella*
  - Live-attenuated vaccine more effective than killed.
- *Salmonella* monitoring program of the breeders’ environment (voluntary): *S. Enteritidis*
- Broiler eggs are held in a pest-proof, temperature-controlled environment
- Limited use of probiotic/competitive exclusion
  - Effectiveness
  - Cost
Top-down *Salmonella* control

1. Elites
2. GGP
3. Grandparents
4. Breeders
5. Broilers
6. Processing
7. Consumer

Vaccination
Breeders

• **EU:**
  – Many countries vaccinate for *Salmonella*
  – Many countries use probiotic/competitive exclusion for *Salmonella*
  – Scandinavian countries (e.g., Denmark, Sweden, Norway) test regularly breeder flocks for *Salmonella*
    • Slaughter the flock if positive for *Salmonella*
    • Works for countries with relatively small poultry industry
Hatchery

• A source of contamination and dissemination of *Salmonella* to newly hatched chicks
• Dust spreads *Salmonella* in the hatchery to many chicks
• **USA** and **EU**:  
  – Some use competitive exclusion for *Salmonella*
  – Control of *Salmonella* in environment by disinfection (e.g., UV light, ozone, and other chemicals)
Biosecurity

• Pest management program to control:
  – Rodents, insects, and wildlife
• Develop a biosecurity program in writing and implement
• Cleaning and disinfecting
• In EU:
  – Test flocks 2 weeks before slaughter
  – If positive, slaughter/process separately

Source: Chuck Hofacre
Litter

• Bedding materials in broiler house

• **USA:**
  – Litter from a previous broiler flock is reused for successive flocks (up to one year)
  – Litter amendments used to control ammonia showed a significant reduction in *Salmonella* prevalence
  – Evidence suggests that *Salmonella* survives less well in used litter than in fresh

• **EU:**
  – The whole litter is removed from a house after each flock
  – House needs to be cleaned thoroughly, disinfected, and dried before new litter
Feed withdrawal

• Feed withdrawal (8 to 12 h) before slaughter
  – Least of amount of feces in the bird gut
  – Reduce the risk that carcasses contaminated with *Salmonella* during processing

• However, feed withdrawal has been shown to increase the number of *Salmonella* contaminated crops and cecas
Feed withdrawal

• USA:
  – Poultry industry use a number of interventions in drinking water during feed withdrawal:
    • Organic acid blend (Parker et al., 2007)
    • Lactic acid (Byrd et al., 2001)
  – Issue with inflamed intestine and lower water consumption
  – Innovative use of Essential Oil-Mix that reduce *Salmonella* prevalence in crop, and enhance bird health
Poultry Processing

USA:

• Bird washers:
  • Post-picker wash
  • Inside/outside bird wash
  • Final bird wash
  – Chlorine used as well as other chemicals
    • Prevent *Salmonella* cross-contamination

• Water immersion chilling
  • Chlorine is used
  • Reduce *Salmonella* prevalence by 50%
Poultry Processing

EU:

• Bird washers:
  – No chemicals are used

• Air-chilling:
  – No chemicals are used
Summary and conclusions

- Surveillance for *Salmonella* on raw poultry is important
- Data can then be used to establish a performance standard and improve the safety of poultry products
- Both pre- and post-harvest interventions are needed to control *Salmonella*
  - No sliver bullet
  - No single solution
Thank You

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