Enumeration of *Salmonella* in Ground Meat and Poultry as a Means to Protect Public Health

A Discussion
June 19, 2013
Agenda

• Objectives
• Background
• Current Regulatory Standards
• How Do We Move Forward
• Case Study: Prevalence vs. Level
• Summary
Objectives

- To discuss how reducing the actual levels of Salmonella (measured by enumeration) in ground meat and poultry products will reduce the number of illnesses associated with these products irrespective of serovar.
- To encourage enumeration options as a means to measure food safety program effectiveness.
- Identify research gaps.
BACKGROUND
Salmonellosis in the United States

Foodborne infections, 2003–05 to 2007–09
↓ Decrease desired

Whereas rates of Campylobacter infections showed almost no change from 2003–05 (12.7 per 100,000) to 2007–09 (12.8 per 100,000), rates of Salmonella infections increased 5.5% from 2003–05 to 2007–09, from 14.5 to 15.3 cases per year per 100,000 population.
Foodborne Illness Outbreaks in Different Commodities 2001-2010

Source: Center For Science In The Public Interest, 2013
Figure 6. Relative Rates of Illness by Food Category Adjusted for Consumption, 2001-2010

- Fruit: 1.0
- Dairy: 1.0
- Vegetables: 2.3
- Pork: 4.0
- Beef: 5.4
- Eggs: 6.3
- Poultry: 6.8
- Seafood: 19.3

Source: Center For Science In The Public Interest, 2013
CURRENT REGULATORY STANDARDS
Salmonella Performance Standards

- 1996 FSIS defined the standard as the number of samples within a sample set that can test positive for generic *Salmonella* (N varies by commodity)
- Qualitative standard (presence or absence)
- Defined by FSIS baselines (measured process capability)
### Performance Standards and Prevalence

<table>
<thead>
<tr>
<th>Product</th>
<th>Original Salmonella Performance Std</th>
<th>Updated Salmonella Performance Std</th>
<th>% positive: 2010 Data 29,734 samples&lt;sup&gt;1&lt;/sup&gt;</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ground Chicken</td>
<td>44.6%</td>
<td></td>
<td>18.8%</td>
</tr>
<tr>
<td>Broilers</td>
<td>20%</td>
<td>9.8%</td>
<td>6.7%</td>
</tr>
<tr>
<td>Ground Turkey</td>
<td>49.9%</td>
<td></td>
<td>10.2%</td>
</tr>
<tr>
<td>Turkeys</td>
<td>NA</td>
<td>7.1%</td>
<td>4.6%</td>
</tr>
<tr>
<td>Market Hog</td>
<td>8.7%</td>
<td></td>
<td>2.4%</td>
</tr>
<tr>
<td>Ground Beef</td>
<td>7.5%</td>
<td></td>
<td>2.2%</td>
</tr>
<tr>
<td>Cow/bull</td>
<td>2.7%</td>
<td></td>
<td>0.5%</td>
</tr>
<tr>
<td>Steer/heifer</td>
<td>1%</td>
<td></td>
<td>0.1%</td>
</tr>
</tbody>
</table>

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<sup>1</sup> [http://www.fsis.usda.gov/PDF/Serotypes_Profile_Salmonella_2010.pdf#page=98](http://www.fsis.usda.gov/PDF/Serotypes_Profile_Salmonella_2010.pdf#page=98), Table 7 (turkey), table 5 (beef), table 6 (chicken), 2010 data
Salmonella Performance Standards

Outcomes

- Provided useful information when first implemented
- An improvement in establishments meeting performance standard criteria
- Overall industry prevalence rates below performance standard criteria
- Meat and poultry are still contributors to salmonellosis
HOW DO WE MOVE FORWARD?
Hypothesis

• The risk of foodborne illness is influenced by the concept of infectious dose; that is, the consumption of different levels of *Salmonella* is correlated with different probabilities of illness.

• Reducing the actual levels of *Salmonella* in ground meat and poultry will reduce the number of illnesses associated with these products irrespective of serovar.

• A heightened focus on enumerating samples of ground meat and poultry and ascertaining the number of *Salmonella* that are present in a given sample, versus relying solely on the qualitative approach of prevalence, will allow for a food safety system more capable of ensuring food related illness, and provide for better public health protection.
Hypothesis - Objections

• How can there be a safe level defined?
• What about the susceptible human population?
• Some serovars are more likely to cause illness than others.
• Isn’t the relationship between prevalence and level correlated?
• Enumeration methodologies are difficult and expensive.

Therefore: the only way to regulate is with prevalence
Model


“Plants with higher average contamination levels and/or higher variation in levels between batches contribute the most to consumer risks and reducing (variation in) contamination in these plants has the highest impact [on public health].”
CASE STUDY: PREVALENCE VS. LEVELS
Average Salmonella MPN and Daily Prevalence in Ground Turkey

Preliminary Data; Ground turkey derived from boneless cuts; 157 days; 394 positive samples of 3988 samples
Case Study: Use of Enumeration in Control Programs

- High Pressure Processing (HPP) product line.
- Raw material: known to have higher prevalence rate and levels of *Salmonella*.
- HPP
  - Validated for 3-4 log destruction in inoculation trials.
  - Does reduce prevalence rate but does not achieve zero
  - Should the success of an intervention like HPP be based solely on qualitative data?
- Proposal: Validate control point to consistently achieve low level of *Salmonella*.
Using Enumeration in Control Programs

- Validation trial
  - 100 data points
  - Validate reduction to point below critical level
  - Critical control points: HPP time, temperature, pressure

- Results
  - Mean values dropped from 1.32 log to 0.40 log
  - Variance dropped from 9.2 log to 2.8 log
  - Number above 1.0 CFU/gram: 19.7% to 4.8%
  - Prevalence rate dropped from 69% to 54%

- Conclusion
  - HPP is a validated intervention for the reduction of high levels of Salmonella (counts >1.0 CFU/gram)
SUMMARY
Research Needs

Enumeration of samples to establish how widely the levels of *Salmonella* in ground meat and poultry products vary;

Understanding the factors that result in the high levels and/or higher variation of *Salmonella* in the product;

Understanding and characterizing treatments that result in the elimination or significant reduction of *Salmonella* in ground meat and poultry products;

Increased development of enumeration methods;

Increased knowledge on infectious dose and risk modeling.
Summary Comments

• Ultimately the hypothesis can be supported.
• Continue to collect the data to overcome the objections.
• Further discussion should take place on how to most effectively use *Salmonella* enumeration data in meat and poultry control programs.
• Control programs and supply chains that focus on achievement of consistently low levels of *Salmonella* are an effective means of managing risk.