Impact of Chilling on Poultry Carcass Microbiology

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Poultry Chilling

- Reduces microbial growth
- Methods include:
  - Traditional Immersion
  - Dry Air or Evaporative (Spray)
Poultry Chilling

- Numerous studies on poultry immersion chilling
- Limited number of studies on dry air and/or evaporative air chilling
- Only a few projects have compared chilling methods
- Many do not cite the chilling conditions and rates or the details are incomplete

Poultry Chilling

- Comprehensive review articles:
  - Brant, 1974. Poult. Sci. 53:1291-1295
  - Thomson et al., 1974. Poultry Sci. 53:1268-1281
  - James et al., 2005. Int. J. Refrig. 20:1-17
Microbiology of Poultry Chilling

- **Salmonella** – Most determined prevalence (# positive) and not numbers
- **Overall, Salmonella prevalence was reduced by immersion and air chilling (1 exp.)**
- **Campylobacter** – Up to 2 log cfu/mL reduction with immersion chilling (WCR)
- **Little change in Campylobacter with air chilling** (neck-skin maceration method; Kuwait)

**Previous Research**

Microbiology of Poultry Chilling

- **Generic Escherichia coli / coliforms** – About 1 log cfu/mL reductions without chlorine and 2 to 3 log cfu/mL reductions with chlorine (20-25 ppm)
- **No significant reductions with air chilling, but again used neck-skin maceration recovery method.**

Effect of Broiler Feed Withdrawal and Transportation on Levels of *Campylobacter*, *Salmonella*, and *E. coli* on Carcasses Before and After Immersion Chilling.

*Poultry Science* 82:169-173

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USDA-ARS Research

- Commercial Campy positive broilers moved to floor pens
- Inoculated with marker *Salmonella*
- Processed at ages 42, 49, and 56-d
- WCR after manual final wash (Pre-chill)
- WCR after chilling with 20 PPM chlorine (Post-chill)

Prototype Tumble Chiller

Effect of Chilling on Counts

Northcutt et al., 2003
**USDA-ARS Research**


Effect of Pre-chill Fecal Contamination on Numbers of Bacteria Recovered from Broiler Chicken Carcasses Before and After Immersion Chilling.

*Journal of Food Protection 67:1829-1833.*

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**USDA-ARS Research**

- Prechill carcasses cut in half
- 3 X 5 cm rectangle on each breast
- 0.1 g “fresh” feces put on one half
- Waited 10 min, spray washed
- Chilled 45 min, half carcass rinse
- Skin pieces removed, stomached

Cason et al., 2004
Fecal Contamination During Processing

**E. coli** in rinses and skin samples
(log counts per half carcass or piece)

<table>
<thead>
<tr>
<th></th>
<th>Post-chill rinse</th>
<th>Skin pieces</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Control</strong></td>
<td>5.4</td>
<td>3.8</td>
</tr>
<tr>
<td><strong>Feces</strong></td>
<td>5.5</td>
<td>3.8</td>
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</tbody>
</table>

Same pattern and comparable counts for *Enterobacteriaceae* and Coliforms
Post Chill Carcass Counts


USDA-ARS Research


Broiler Carcass Bacterial Counts After Immersion Chilling Using Either a Low or High Volume of Water.

Poultry Science submitted for publication.
Half of each pair was chilled in either 0.25 gal / pound or 2 gal / pound of non-chlorinated water.

After 45 min, removed rinsed.

Northcutt et al., 2006.

**Carcass Bacterial Counts**

Northcutt et al., 2006. Submitted to Poultry Science.
Immersion Chiller Water Counts

Northcutt et al., 2006. Submitted to Poultry Science

University of Bristol


Microbial Cross-Contamination During Air Chilling of Poultry

British Poultry Science 41:158-162.
Materials and Methods
- Marker Strain of *E. coli* on one carcass
- Evaporative Air Chilling – 50 PPM Chlorine
- Dry Air Chilling
- Evaluated contamination +/- 10 carcasses away from contaminated


Mead et al., 2000

= Inoculated
10 mL of $10^9$ cfu/mL

= Sampled
Evaporative Air Chilling

Mead et al., 2000

Dry Air Chilling

Mead et al., 2000
Conclusions

- Immersion chilling causes at least 1.0 log reduction in carcass pathogenic bacteria
- Post chill, fecally-contaminated carcasses are microbiologically equivalent to non-contaminated carcasses
- Potential exists for cross-contamination during immersion and air chilling, particularly if antimicrobials are missing, or not used correctly (monitored)