

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- Many do not cite the chilling conditions and rates or the details are incomplete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, 1963. Poultry Processing and Marketing 69:14-23
 - Brant, 1974. Poult. Sci. 53:1291-1295
 - Thomson et al., 1974. Poultry Sci. 53:1268-1281
 - Lillard, 1982. Food Technol. 36:58-67
 - James et al., 2005. Int. J. Refrig. 20:1-17

Previous Research

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.

USDA-ARS Research

Northcutt, J. K., M. E. Berrang, J. A. Dickens, D. L. Fletcher, and N. A. Cox. 2003.

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

USDA-ARS Research

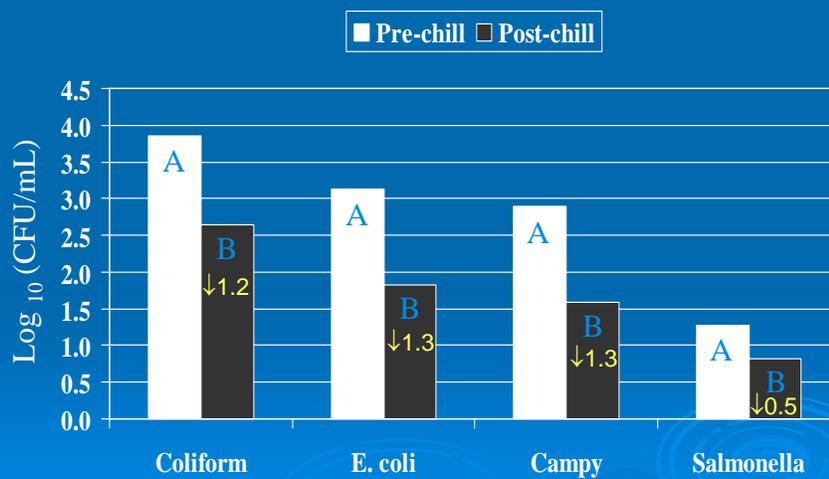
- Commercial Campy positive broilers moved to floor pens
- Inoculated with marker *Salmonella*
- Processed at ages 42, 49, and 56-d
- WCR after manual final wash (Pre-chill)
- WCR after chilling with 20 PPM chlorine (Post-chill)

Northcutt et al., 2003. *Poultry Science* 82:169-173

Prototype Tumble Chiller



Effect of Chilling on Counts



Northcutt et al., 2003

USDA-ARS Research

Cason, J. A., M. E. Berrang, R. J. Buhr, and N. A. Cox. 2004.

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.

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)

	<u>Post-chill rinse</u>	<u>Skin pieces</u>
Control	5.4	3.8
Feces	5.5	3.8

Same pattern and comparable counts
for *Enterobacteriaceae* and Coliforms

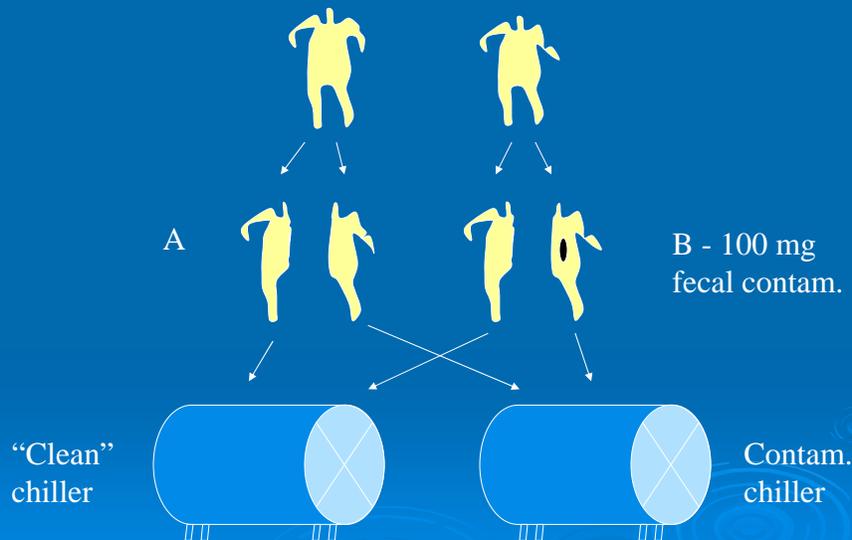
USDA-ARS Research

Smith, D. P., J. A. Cason and M. E. Berrang.
2005.

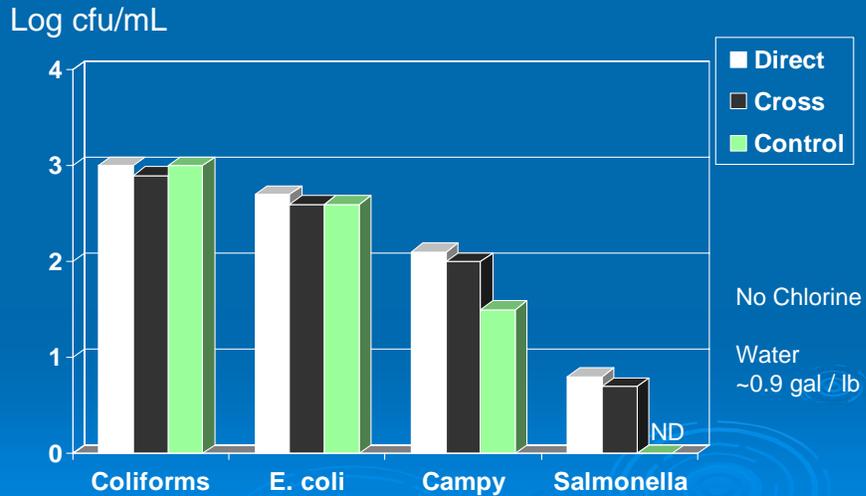
The Effect of Fecal Contamination and Immersion
Chilling on *Escherichia coli*, Coliform,
Campylobacter, and *Salmonella* Counts of Broiler
Carcasses.

Journal of Food Protection 687:1340-1345.

Design Diagram



Post Chill Carcass Counts



Smith et al., 2005. Journal of Food Protection 68:1340-1345.

USDA-ARS Research

Northcutt, J. K., J. A. Cason, D. P. Smith, R. J. Buhr, and D. L. Fletcher. 2004.

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

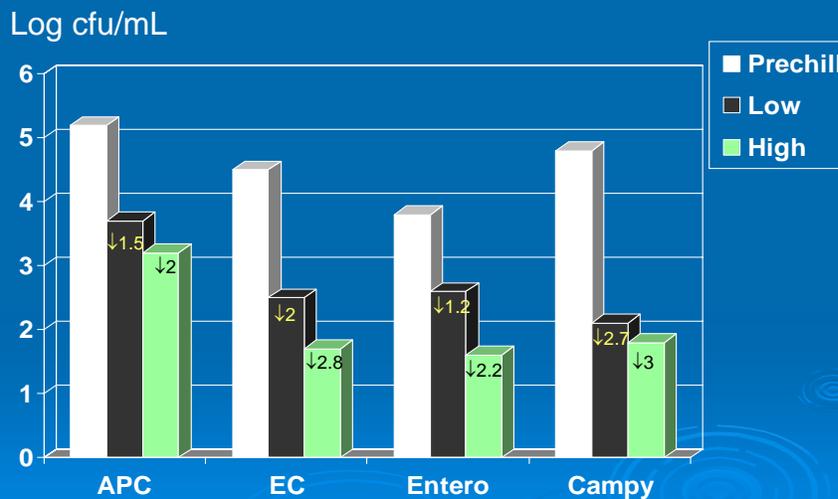
Poultry Science submitted for publication.



- 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

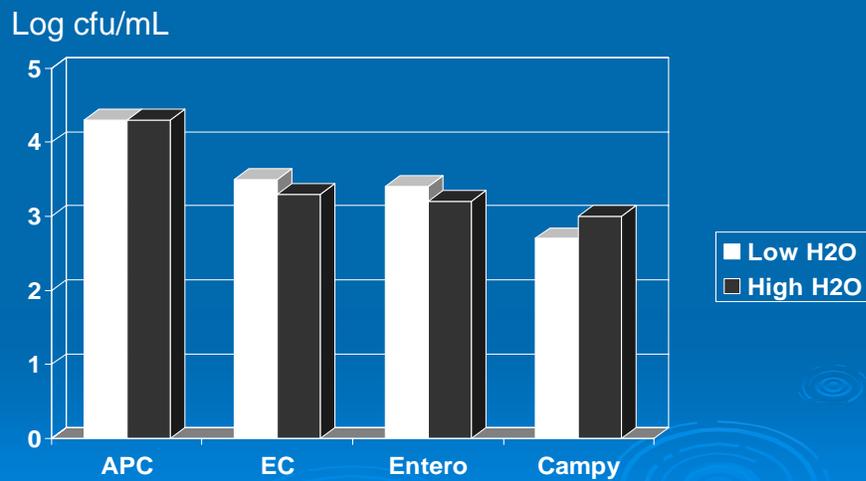
Northcutt et al., 2006

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

Mead, G. C., V. M. Allen, C. H. Burton, and J. E. L. Corry. 2000.

Microbial Cross-Contamination During Air Chilling of Poultry

British Poultry Science 41:158-162.

University of Bristol

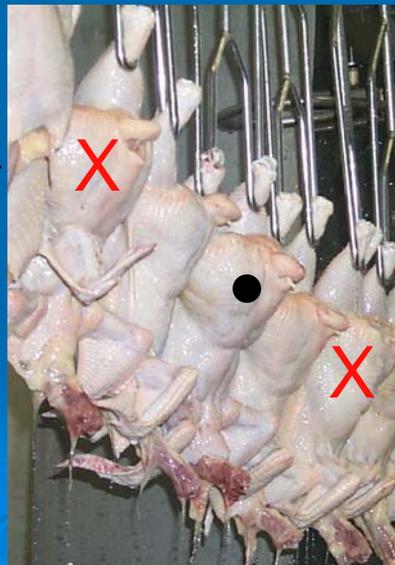
- Materials and Methods
 - Marker Strain of *E. coli* on one carcass
 - Evaporative Air Chilling – 50 PPM Chlorine
 - Dry Air Chilling
 - Evaluated contamination +/- 10 carcasses away from contaminated

Mead et al., 2000. British Poultry Science 41:158-162.

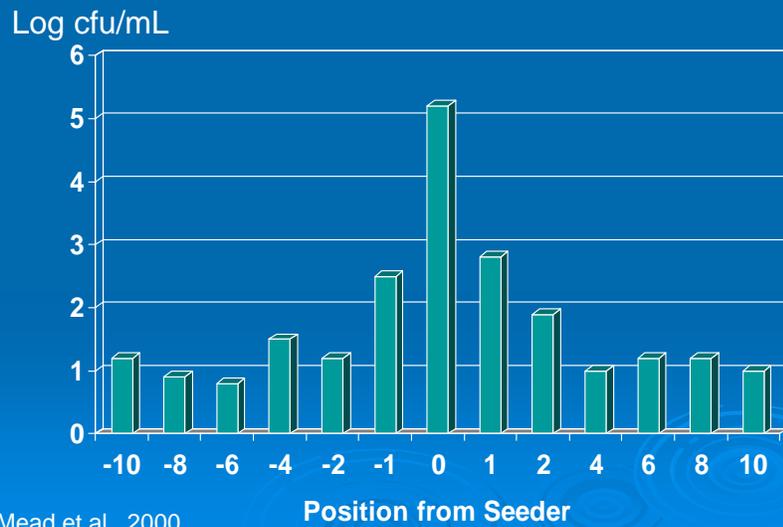
Mead et al., 2000

● = Inoculated
10 mL of 10^9 cfu/mL

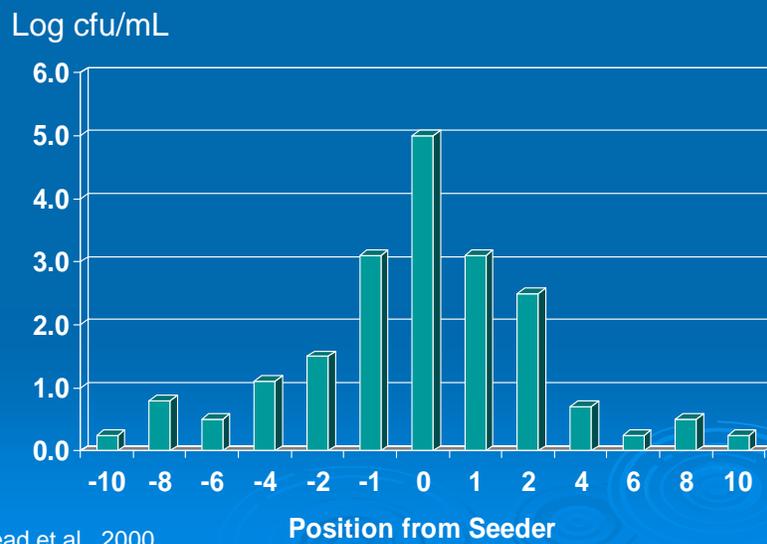
X = Sampled



Evaporative Air Chilling



Dry Air Chilling



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)

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