Effectiveness of Interventions to Reduce or Eliminate Pathogens on Beef

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### Published Data on Decontaminating Treatments for Beef

<table>
<thead>
<tr>
<th>Type</th>
<th>Description</th>
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</thead>
<tbody>
<tr>
<td>Type 1.</td>
<td>Laboratory studies with, usually, inoculated portions of meat. Provide proofs of concepts.</td>
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<tr>
<td>Type 2.</td>
<td>Pilot scale studies with commercial product. Provide proofs of efficacies in practice.</td>
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<tr>
<td>Type 3.</td>
<td>Study of routine treatments at packing plants. Establish effects in practice.</td>
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Carcass Decontaminating Treatments

- Washing or dehairing skin-on carcasses.
- Washing uneviscerated carcasses and dressed sides.
- Spraying uneviscerated carcasses and dressed sides.
- Vacuum/hot water cleaning.
- Trimming.
- Pasteurizing.
Washing or Dehairing of Skin-on Carcasses

**Washing**

1. • Enterobacteriaceae on hides reduced by 3 log units.
   • Enterobacteriaceae on carcasses reduced by < 1 log unit.
   • \textit{E. coli} O157:H7 prevalence on carcasses reduced from 17 to 2%.
2. • \textit{E. coli} O157:H7 prevalence on hides reduced from 98 to 90%.
   • \textit{E. coli} O157:H7 prevalence at number > 0.4 cfu/cm² reduced from 35 to 13%

**Dehairing**

• Numbers of Enterobacteriaceae on hides not affected.
• Numbers of Enterobacteriaceae on carcasses reduced by 2 log units.
• \textit{E. coli} O157:H7 prevalence on hides reduced from 88 to 67%.
• \textit{E. coli} O157:H7 prevalence on carcasses reduced from 50 to 1%.
Washing Uneviscerated or Dressed Carcasses

- Aerobe numbers are reduced by 1 log unit when initial numbers are $\geq 4 \log \text{cfu/cm}^2$.
- *E. coli* numbers are reduced by 1 log unit when initial numbers are $> 1 \log \text{cfu/cm}^2$.
- The amount of water used on each carcass is probably important for reducing numbers of bacteria.
- Repeated washing will not give further reductions unless carcasses are heavily recontaminated.
Spraying Warm Carcasses with Antimicrobial Solutions

- To be effective, solutions must cover all carcass surfaces and be at inactivating concentrations.
- Washing uneviscerated carcasses then spraying with 2% lactic acid is no more effective than washing alone.
- Spraying with an antimicrobial solution before or after pasteurizing is probably no more effective than pasteurizing alone.
Trimming and Vacuum/Hot Water Cleaning

- Visible contamination is not a good indicator for microbial contamination.
- A trimming or cleaning operation does not affect the microbiological condition of the site on carcasses designated for treatment in the operation.
- Trimming of detained carcasses may reduce numbers at trimmed sites by up to 2 log units, because of removal of bacteria from the < 20% of sites that are heavily contaminated.
Pasteurizing carcasses with steam or hot water can reduce aerobes by $>1$ and *E. coli* by $>2$ log units.

<table>
<thead>
<tr>
<th>Medium</th>
<th>Aerobes (log cfu/cm²)</th>
<th>E. coli (log cfu/2500cm²)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Before</td>
<td>After</td>
</tr>
<tr>
<td>Steam</td>
<td>3.36</td>
<td>2.24</td>
</tr>
<tr>
<td></td>
<td>2.90</td>
<td>1.63</td>
</tr>
<tr>
<td></td>
<td>2.02</td>
<td>0.73</td>
</tr>
<tr>
<td>Water</td>
<td>3.30</td>
<td>1.98</td>
</tr>
<tr>
<td></td>
<td>3.30</td>
<td>2.28</td>
</tr>
</tbody>
</table>

If *E. coli* counts before pasteurizing are < 1 cfu/cm² and the pasteurizing treatment is effective, then *E. coli* on pasteurizing carcasses will be < 1 cfu/1000 cm².
Plant Data for *E. coli* in Carcasses

- *E. coli* are detected at 1 cfu/12 cm².
- Prevalences of *E. coli* – positive samples at three plants were 0.05%, 0.21% and 2.9%;
- Most positive samples gave only 1 cfu;
- If distribution is log normal and standard deviation is 1 log unit;
- Then, mean *E. coli* number are < 1 cfu/1000 cm², about 1 cfu/1000 cm², and about 1/100 cm²;
- And numbers of *E. coli* O157 on carcasses must be disappearingly small;
**E. coli on Carcasses and in Ground Beef**

- *E. coli* on carcasses are 1/1000 cm², so a side will carry about 15 cfu.
- A side will give about 50 kg of ground beef.
- If meat is not contaminated after carcass pasteurizing, *E. coli* in ground beef would be 3 cfu/10 kg.
- Numbers of *E coli* in ground beef are about 3 cfu/g.
- Therefore, most *E coli* in ground beef are deposited and/or grow on the meat after carcasses are pasteurized.
Carcass Cooling

- Areobes increases of about 1 log unit are usual.
- *E. coli* numbers may increase, remain unchanged, or decrease.
- At two plants *E. coli* numbers remained < 1 cfu/1000 cm².
- At two plants, *E. coli* numbers increased by 1 log unit to 1 cfu/1000 cm² and 1 cfu/cm².
- Adequacy of control over *E. coli* growth can be decided from surface temperature history data.
- Contamination from contact with fixtures, workers, wash waters, etc. can be prevented.
- Hanging beef can be decontaminated with 4% lactic acid;
Carcass Breaking

• In four processes, numbers of *E. coli* on cuts were 0, 1, 2 or 4 log units more than numbers on carcasses.

• In two processes, numbers of *E. coli* on trimmings were 1 or 3 log units more than numbers on carcasses.

• The source of additional contaminants is detritus that cannot be removed from fixed or personal equipment during routine cleaning.

• Conveyors cannot be freed of detritus during routine cleaning.
Control of Contamination During Carcass Breaking

• Contamination during breaking of carcasses at a large pork packing plant did not occur, because all equipment was dried after cleaning and kept dry during processing.

• Personal equipment can be largely freed of *E. coli* by immersion in hot water.

• *E. coli* on trimmings can be reduced by 2 log units by pasteurizing in water of 85°C for 45 s.

• Except for a slightly paler color, ground beef prepared from pasteurized trimmings is indistinguishable from unpasteurized product.
Conclusions

• The hides of most cattle are contaminated with *E. coli* O157:H7.
• Current carcass dressing and decontaminating practices can give carcasses with *E. coli* < 1 cfu/1000 cm².
• Beef is recontaminated with *E. coli* that include *E. coli* O157:H7 during carcass breaking processes.
• Recontamination can be prevented if breaking facilities and equipment are kept dry.
• Pasteurizing of trimmings could assure their microbiological safety.
• Safety cannot be tested into a product.