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# Effectiveness of Interventions to Reduce or Eliminate Pathogens on Beef

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## Published Data on Decontaminating Treatments for Beef

- Type 1. Laboratory studies with, usually, inoculated portions of meat. Provide proofs of concepts.
- Type 2. Pilot scale studies with commercial product. Provide proofs of efficacies in practice.
- Type 3. Study of routine treatments at packing plants. Establish effects in practice.

# 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.
  - *E. coli* O157:H7 prevalence on carcasses reduced from 17 to 2%.
2.
  - *E. coli* O157:H7 prevalence on hides reduced from 98 to 90%.
  - *E. coli* O157:H7 prevalence at number > 0.4 cfu/cm<sup>2</sup> reduced from 35 to 13%

## Dehairing

- Numbers of Enterobacteriaceae on hides not affected.
- Numbers of Enterobacteriaceae on carcasses reduced by 2 log units.
- *E. coli* O157:H7 prevalence on hides reduced from 88 to 67%.
- *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

- Pasteurizing carcasses with steam or hot water can reduce aerobes by  $> 1$  and *E. coli* by  $> 2$  log units.

| Medium | Aerobes (log cfu/cm <sup>2</sup> ) |       | <i>E. coli</i> (log cfu/2500cm <sup>2</sup> ) |       |
|--------|------------------------------------|-------|---|-------|
|        | Before                             | After | Before  | After |
| Steam  | 3.36                               | 2.24  | 3.84  | 1.11  |
|        | 2.90                               | 1.63  | 2.51  | n.d.  |
|        | 2.02                               | 0.73  | 3.19  | n.d.  |
| Water  | 3.30                               | 1.98  | 3.58  | 0.85  |
|        | 3.30                               | 2.28  | 2.45  | 1.08  |

- If *E. coli* counts before pasteurizing are  $< 1$  cfu/cm<sup>2</sup> and the pasteurizing treatment is effective, then *E. coli* on pasteurizing carcasses will be  $< 1$  cfu/1000 cm<sup>2</sup>.



## Plant Data for *E. coli* in Carcasses

- *E. coli* are detected at 1 cfu/12 cm<sup>2</sup>.
- 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 cm<sup>2</sup>, about 1 cfu/1000 cm<sup>2</sup>, and about 1/100cm<sup>2</sup>;
- 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 cm<sup>2</sup>, 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

- Areobe 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 cm<sup>2</sup>.
- At two plants, *E. coli* numbers increased by 1 log unit to 1 cfu/1000 cm<sup>2</sup> and 1 cfu/cm<sup>2</sup>.
- 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 cm<sup>2</sup>.
- 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.



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