Evaluation of Sodium Chlorate, With and Without Nitroethane, on *Salmonella* and *E. coli* O157:H7 in Cull Dairy Cattle

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Study Completed
2009

Funded by The Beef Checkoff
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Project Summary

Background
Every year more than 76 million Americans become ill from the consumption of food contaminated with pathogenic bacteria. The bovine gastrointestinal tract is a well recognized reservoir for bacterial pathogens like *Escherichia coli* O157:H7, *Salmonella* and *Campylobacter*. In the United States these bacterial pathogens are responsible for more than 3.5 million human infections annually at an estimated annual cost of more than $3.5 billion a year. As many as 66% of the cull dairy cow markets have detectable amounts of *Salmonella* shedding and these cull cow markets contribute substantially to the ground beef available for consumption. Thus, pre-harvest intervention strategies that reduce the shedding of food-borne pathogens in cull dairy cattle are essential to reducing the amount of pathogenic bacteria entering slaughter facilities and potentially contributing to contamination of food products and human infections.

Sodium chlorate supplementation has been investigated as a pre-harvest food safety strategy to reduce *Salmonella* and *E. coli* O157:H7 in vitro and in food producing animals. Research has also shown that the addition of short chained nitro compounds like nitroethane can enhance the ability of sodium chlorate to reduce if not kill *Salmonella* and *E. coli* as much as ten-fold in vitro and in vivo. Based on the research done to date, sodium chlorate technology shows great promise for reducing *Salmonella* and *E. coli* O157:H7 pre-harvest. The objective of the current research was to determine if feeding sodium chlorate, with and without nitroethane, is effective in reducing populations of *Salmonella*, *E. coli* O157:H7 and generic *E. coli* in cull dairy cattle on a commercial dairy prior to slaughter.

Methodology
All cattle were obtained from a conventional commercial dairy in the southwestern United States. Dairy cows that were sent to the hospital pens per the dairy’s standard operating procedures were prescreened for *Salmonella*. Five days post-sampling, animals confirmed as *Salmonella* positive were enrolled in this study. Twelve lactating Holstein dairy cows (average BW 545 kg) testing positive for *Salmonella* were purchased from the dairy and six animals were randomly assigned to each treatment (chlorate or chlorate + nitroethane). All experimental animals remained on the dairy and were housed in a pen separate from the rest of the dairy herd, otherwise all feeding and management schemes were as normal for the dairy.

*Salmonella* positive animals received 42 mg/kg BW/d sodium chlorate or 21 mg sodium chlorate/kg BW + 160 mg nitroethane kg/BW/d. Treatments were administered 4 times at 12 h intervals via stomach tube. Fecal grab samples were collected just prior to first dosing and subsequently every 12 h for the next 48 h post initial dosing. Following the last fecal collection animals were humanely euthanized. Luminal contents and tissues from the rumen, small intestine, cecum, spiral colon and rectum were aseptically collected upon necropsy and analyzed for quantitative and qualitative bacterial culture of *Salmonella*, *E. coli* O157:H7, generic *e. coli* and fecal coliforms.

Findings
The scope of this experiment was to evaluate the effects of sodium chlorate with and without nitroethane on fecal shedding of *Salmonella*, *E. coli* O157:H7 and generic *E. coli* in cull dairy cows.
The experiment was performed on the farm to ensure that daily farm practices and feeding regimes were employed in an effort to accurately simulate real world application of the sodium chlorate and sodium chlorate + nitroethane products. Two animals in the chlorate treatment group were shedding *Salmonella* at high concentrations at the time of pre-screening. Figure 1 demonstrates the ability of the sodium chlorate product to effectively reduce (5 logs) *Salmonella* in animals colonized with high concentrations. The remaining animals were positive for *Salmonella* following enrichment at pre-screening. Forty-eight hours post initial treatment with sodium chlorate all animals were negative for *Salmonella* via spiral plating and only fifty percent of the animals had any detectable amount of *Salmonella* from enriched samples. Sodium chlorate + nitroethane treatment resulted in all animals testing negative for *Salmonella* via spiral plating and only thirty three percent of the animals had any detectable amount of *Salmonella* from enriched samples. Luminal contents from the sites sampled at necropsy yielded no detectable *Salmonella* via direct plating for all animals regardless of treatment. Animals were negative for *E. coli* O157:H7 via direct plating and enrichments. Generic *E. coli* and fecal coliforms were high across all animals tested for fecal samples taken over time post dosing suggesting that there was little effect of the sodium chlorate or sodium chlorate + nitroethane treatments on generic *E. coli* or fecal coliforms.

The results of the research presented herein support the use of chlorate as a pre-harvest intervention for use in cull dairy cattle. Administration of sodium chlorate immediately following the decision to cull an animal should allow adequate time for the chlorate to exert its killing effect on *Salmonella* prior to the animal entering the slaughter facility. While the sodium chlorate did not kill 100% of the cultured *Salmonella*, it did significantly reduce populations in the high shedders to levels that are effectively controlled by modern processing intervention strategies. Subsequent research should examine the effectiveness of on-farm sodium chlorate administration by following cull animals through the slaughter process.

![Figure 1](image-url)  
**FIGURE 1.** Effect of sodium chlorate administration on *Salmonella* concentrations in the feces of two cull dairy cattle over a 48 hour time frame.
Implications
Results of this research demonstrate the ability of sodium chlorate to effectively reduce *Salmonella* populations in cull dairy cattle. On-farm administration of this compound upon identification of an animal for culling should effectively reduce the *Salmonella* burden entering the slaughter facilities, thereby providing a safer beef product to the consumer.

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