

2005

## Effects of cetylpyridinium chloride treatment of roast beef on *Listeria monocytogenes* populations and quality attributes

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### Recommended Citation

Singh, M.; Thippareddi, H.; Herald, T.J.; Phebus, Randall K.; Marsden, James L.; and Nutsch, Abbey L. (2005) "Effects of cetylpyridinium chloride treatment of roast beef on *Listeria monocytogenes* populations and quality attributes," *Kansas Agricultural Experiment Station Research Reports*: Vol. 0: Iss. 1. <https://doi.org/10.4148/2378-5977.1603>

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# Effects of cetylpyridinium chloride treatment of roast beef on *Listeria monocytogenes* populations and quality attributes

## Abstract

The effectiveness of cetylpyridinium chloride (CPC) for reducing microbial populations, in particular *Listeria monocytogenes*, on ready-to-eat roast beef was evaluated. Roast beef slices inoculated with *L. monocytogenes* were dipped in a solution of 1% CPC for 1 minute. Samples were then vacuum packaged and stored at refrigeration temperature. The effects of CPC treatment on microbial populations, as well as on color and texture of the roast beef samples, was evaluated over a 42-day period. Immediately after CPC treatment, *L. monocytogenes* populations were reduced by 99 to 99.99%, with the treatment being somewhat more effective on exterior than on sliced/cut surfaces. Throughout 42 days of refrigerated storage, populations of *L. monocytogenes*, total bacteria, and lactic acid bacteria remained lower on CPC-treated samples than on non-treated samples. Treatment with CPC did not significantly affect the color or texture of roast beef. Treatment with CPC, especially when applied to products before slicing, may serve as an effective antimicrobial intervention for ready-to-eat meat products.

## Keywords

Cattlemen's Day, 2005; Kansas Agricultural Experiment Station contribution; no. 05-144-S; Report of progress (Kansas State University. Agricultural Experiment Station and Cooperative Extension Service); 943; Beef; Cetylpyridinium chloride; *Listeria monocytogenes*; Roast beef

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## EFFECTS OF CETYLPYRIDINIUM CHLORIDE TREATMENT OF ROAST BEEF ON *LISTERIA MONOCYTOGENES* POPULATIONS AND QUALITY ATTRIBUTES

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### Summary

The effectiveness of cetylpyridinium chloride (CPC) for reducing microbial populations, in particular *Listeria monocytogenes*, on ready-to-eat roast beef was evaluated. Roast beef slices inoculated with *L. monocytogenes* were dipped in a solution of 1% CPC for 1 minute. Samples were then vacuum packaged and stored at refrigeration temperature. The effects of CPC treatment on microbial populations, as well as on color and texture of the roast beef samples, was evaluated over a 42-day period. Immediately after CPC treatment, *L. monocytogenes* populations were reduced by 99 to 99.99%, with the treatment being somewhat more effective on exterior than on sliced/cut surfaces. Throughout 42 days of refrigerated storage, populations of *L. monocytogenes*, total bacteria, and lactic acid bacteria remained lower on CPC-treated samples than on non-treated samples. Treatment with CPC did not significantly affect the color or texture of roast beef. Treatment with CPC, especially when applied to products before slicing, may serve as an effective antimicrobial intervention for ready-to-eat meat products.

### Introduction

*Listeria monocytogenes* is a foodborne pathogen of significant public health concern due to the severity of disease in susceptible individuals. Approximately 1,700 cases of

listeriosis are reported annually in the United States, but the source of infection is usually not determined. Ready-to-eat meat products are among the products most commonly associated with foodborne listeriosis. The U.S. Department of Agriculture Food Safety and Inspection Service classifies deli-type products that are sliced at the point of production or at retail, such as cured hams, roast beef or turkey, bologna, luncheon meat, pastrami, and other cold cuts, as high-risk products.

The microbiological safety of ready-to-eat meat products can be enhanced by applying interventions such as organic acids and post-packaging pasteurization technologies. A product known commercially as CECURE™ (Safe Foods Corporation, North Little Rock, Arkansas) is a 40% concentrate of cetylpyridinium chloride (CPC), a quaternary ammonium compound that is the active ingredient in some mouthwashes. CPC has been shown to be effective against foodborne pathogens such as *Escherichia coli* O157:H7, *Salmonella* spp., *Listeria* spp., and *Campylobacter* spp. in a variety of food matrices. This study was designed to examine the effectiveness of CPC for eliminating *L. monocytogenes* contamination on exterior and cut/sliced roast beef surfaces before packaging, and to determine the influence of CPC treatment on quality attributes (color and firmness).

### Procedures

Roast beef was cut into slices (6 × 6 × 2 inches), with each slice having a "sliced/cut"

surface and an "exterior" surface (original surface in contact with the casing during cooking operations). Slices were inoculated with *L. monocytogenes* at either a low concentration (approximately 1,000 colony forming units [CFU]/cm<sup>2</sup>) or a high concentration (approximately 10,000,000 CFU/cm<sup>2</sup>). Roast beef samples used to evaluate the effect of CPC treatment on color and texture were not inoculated.

Individual slices (both inoculated and non-inoculated) of roast beef were treated by immersing in a 77°F solution of 1% CPC for 1 minute. Slices were then vacuum packaged and stored at either 32°F (in dark conditions) or at 39°F (in a lighted display) for 42 days. Samples were analyzed on days 0, 3, 7, 14, 21, 28, and 42 of storage.

Tissue samples were excised from both the exterior surface and the sliced/cut surface of roast beef slices. Samples were homogenized with 0.1% sterile diluent in a blender for 2 minutes, and serial dilutions were then prepared in sterile diluent. *L. monocytogenes* populations were determined by plating on modified Oxford agar and tryptose phosphate agar with incubation at 95°F for 24 to 48 hours. Non-inoculated roast beef samples were also analyzed for total aerobic plate counts and lactic acid bacteria (naturally occurring bacterial populations).

The color attributes (L\* values for lightness; a\* values for redness; and b\* values for yellowness) of roast beef samples were evaluated with a Hunter Miniscan spectrophotometer. A Stable Micro Systems TA-XT2 texture analyzer was used to determine firmness.

## Results and Discussion

Treatment of roast beef slices with CPC resulted in an immediate initial reduction of *L. monocytogenes* populations, with a 99% reduction observed on sliced/cut surfaces, and a 99.99% reduction observed on exterior surfaces. Although CPC treatment did not completely eliminate *L. monocytogenes* from the roast beef samples, remaining populations were significantly lower on CPC-treated samples than on non-treated samples throughout the 42-day storage period.

The total aerobic plate counts of both treated and non-treated roast beef samples gradually increased over storage time, but the populations on CPC-treated samples increased more slowly than on non-treated samples. At the end of the 42-day storage period, populations of non-treated samples were approximately 10,000 CFU/cm<sup>2</sup>, whereas populations on CPC-treated samples were approximately 100 CFU/cm<sup>2</sup>. Similar trends were observed for lactic acid bacterial populations.

Treatment with CPC did not significantly impact the color or texture of roast beef samples, indicating that the effect of CPC treatment on color and texture would be of no practical importance.

Results from this experiment provide evidence of the ability of CPC to reduce *L. monocytogenes* contamination on ready-to-eat deli products, such as roast beef. Because no detrimental impacts on product quality were observed, the use of CPC as an antimicrobial treatment for ready-to-eat deli products before to slicing warrants further exploration.