# Blade Tenderization and Food Safety

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## Introduction

Beef has long been considered a staple of the American diet, due to its availability and versatility. However, the beef industry must provide consistent quality and uniformity in its products to remain competitive. Most consumers judge quality and overall acceptability of beef products based on tenderness. Blade tenderization is one of the most effective and efficient technologies currently used to ensure tenderness.

While sensory characteristics of blade tenderized meat products have been extensively researched, microbiological aspects of the process have not been investigated to the same degree. Although the generic microbiological quality of blade tenderized muscle has been shown to be equivalent to non-tenderized controls (Boyd et al., 1978), bacteria were translocated into the interior of the muscle (Johnston et al., 1979). Therefore, research is required to quantify this bacterial relocation, identify critical control points to minimize the risk for pathogenic contamination, and define effective control measures (cooking schedules) for resultant products.

The National Advisory Committee on Microbiological Criteria for Foods (NACMCF), Meat and Poultry Subcommittee (1997) stated that "*Due to the low probability of pathogenic organisms being present in or migrating from the external surface to the interior of beef muscle, cuts of intact muscle (steaks) should be safe if the external surfaces are exposed to temperatures sufficient to effect a cooked color change*." However, if the surface of an intact muscle or muscle system is violated by mechanical tenderization (blade tenderization), contamination may be carried from the surface to the interior of the cut. The NACMCF, Meat and Poultry Subcommittee (1997) stated that there is a lack of scientific data to address the hazards associated with those processes that may cause translocation of pathogens. Because of the widespread use of the blade tenderization technology and the potential food safety risks it may pose, the Beef Industry Food Safety Council (BIFSCO) identified this research as a priority for the beef industry. This industry group facilitates input from producers, packers, processors, distributors, restaurants, and food retailers in an effort to identify and implement workable *Escherichia coli* O157:H7 controls in the beef industry.

Research is required to establish processing and preparation protocols to ensure safety of blade tenderized beef products. Unlike ground beef, which is almost exclusively cooked to 160°F by food service establishments as a result of USDA and state health department recommendations, mechanically tenderized steaks are often perceived as whole muscle cuts and are prepared to customer specifications, which could potentially pose a health risk to consumers. By characterizing the process and validating cooking protocols for destruction and elimination of *E. coli* O157:H7, suppliers and food service industry will be able to effectively establish standard cooking recommendations for preparation of these products.

## Summary of Kansas State University Research

The potential for translocation of organisms from the surface of whole muscle to the interior of muscle via the blade tenderization process was evaluated. In Study One, beef top sirloin subprimals were inoculated with $10^6$ cfu/cm$^2$ of *E. coli* O157:H7, and passed once through a blade tenderizer. Core samples were aseptically removed from the subprimals and sliced into cross-sectional strips. Results indicate that the blade tenderization process transfers 3-4% of surface contamination to the interior of the muscle. Study Two evaluated thermal destruction of *E. coli* O157:H7 in blade tenderized steaks under an oven broiling element. Six top sirloin subprimals were inoculated with a five strain cocktail to a level of ca. $10^7$ cfu/cm$^2$ on the top surface. Three subprimals were passed once through a tenderizer and the other three were left non-tenderized to serve as controls. Steaks of varying thicknesses (i.e. weights) were cut from each of the subprimals and cooked to one of six endpoint temperatures (120, 130, 140, 150, 160, and 170°F). After removal from the oven, steaks were immersed in an ice bath to halt thermal lethality, and cooled to a temperature below 100°F before sampling. A target internal temperature of 120°F produced greater ($p < 0.05$) log reductions (CFU/g) in non-tenderized (NT) vs. tenderized (T) steaks (5.2 log reduction vs. 3.2 log reduction). At 130°F, T and NT steaks produced 5.6 and 5.0 log reductions, respectively, which was not significantly different, likely due to high standard deviations in bacterial

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counts, especially in low weight steaks. At endpoint temperatures of 140°, 150°, 160°, and 170°F, log reductions were greater than 6 logs in both T and NT steaks, which represented virtually complete destruction. It was observed that even after immersion in an ice bath, internal temperatures continued to rise above the target temperatures by as much as 11°F (in 5 oz steaks). In food service application, where steaks would not be rapidly cooled in this manner, an additional margin of safety would be incorporated into the cooking process. At cooking temperatures ranging from rare (130°F) to well done (170°F), there were no differences in *E. coli* O157:H7 between intact and non-intact steaks using the oven broiling method. Both intact and non-intact steaks are safe for consumers when cooked to the endpoint temperatures evaluated in the study by the oven broiling method.

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