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Methods to reduce E. coli contamination of mechanically tenderized beef

Project Title:

E. coli O157:H7 Research and Education Strategy: Rapid Response Phase

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Researchers:

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- Effects on Survival of Escherichia coli O157:H7 in Non-Intact Steaks of the Frequency of Turning Over Steaks During Grilling
- Journal of Food Protection (6:919-926)

Background:

After a major beef recall in 2012 due to *E. coli* at a large Canadian beef processing facility, potential areas for contamination were examined to prevent this type of recall from happening again. Some potential areas for contamination included hide removal, offal, trim and mechanically tenderized products.

All food surfaces carry bacteria, including steaks and roasts. Because beef cooks from the outside in, the outer surface is exposed to higher temperatures for a longer time than the inside of the beef. The heat of cooking will inactivate bacteria as long as they remain on the outside of cuts, and the surface is cooked thoroughly. That's why steaks and roasts can be eaten rare. In ground beef, microbes from the surface get mixed throughout the beef, so consumers are encouraged to cook ground beef to an internal temperature of 71 ^{o}C.

Mechanical tenderization pierces beef with small blades or fine needles. This cuts the connective tissue and makes the beef more tender. This improves the eating quality of lower cost, tougher beef cuts. Price and tenderness are two of the major drivers of consumer buying behavior and eating satisfaction, so mechanical tenderization has proven quite useful. Approximately 20% of Canadian beef is mechanically tenderized.

But if there are microbes of the surface of the steak, mechanical tenderization may push some of them deeper into the muscle. Other steaks in the same processing batch may be cross-contaminated if the blades transfer microbes from one steak to the other. Taking care to disassemble, thoroughly clean, sanitize and dry the equipment between batches is critical to minimize this risk. This risk became very apparent in 2012, when several *E. coli* O157:H7 infections in people were linked to mechanically tenderized beef.

In response, Health Canada proposed labelling mechanically tenderized beef with recommended cooking instructions. Initially, the proposed label recommended cooking mechanically tenderized beef to 71^{o}C (well-done).

This posed a dilemma for packers, retailers and restaurants. Mechanical tenderization makes beef more tender but cooking a steak until it is well-done makes it tougher, drier and less tasty. If consumers are asked to choose between eating satisfaction and safety, they may choose not to buy beef. Canada's beef industry should be able to ensure both satisfaction and safety.

Objectives:

1. To determine the effects of washing hide-on carcasses with 1.5% caustic soda on the microbiological conditions of beef carcasses before skinning, after skinning and at the end of the dressing process,
2. To determine optimal procedures for cleaning equipment used for mechanical tenderizing of beef,
3. To determine cooking temperatures that ensure the microbiological safety of mechanically tenderized beef (MTB), and
4. To determine the current microbiological condition of offal meats, the effects of treatment with 5% lactic acid on the microbiological condition, and the effects of pasteurizing treatment on the microbiological conditions of offal meats and beef trimmings.

What They Did:

Do determine the effects of the carcass wash, samples were collected in winter, spring and fall, from the rumps of hide-on carcasses before and after washing, from the rumps and briskets of skinned carcasses and from random sites on dressed carcasses. 25 samples were obtained at each stage of processing and sampling site type during each season. These samples where then tested for the presence of *E. coli*.

To look at mechanical tenderization, eye of round steaks (1 to 3 cm thick) were deliberately inoculated with known amounts of *E. coli* O157:H7. The *E. coli* inoculation sites were marked with a dye. After refrigeration, the steaks were barbequed or cooked on a hot plate (skillet). Internal temperature was monitored at various locations in the steak during cooking. Some steaks were flipped once during cooking, some were flipped twice, and others flipped more often. Steaks were cooked until the centers reached temperatures ranging from 56^{o}C to 75^{o}C. The numbers of *E. coli* that survived the cooking process were counted.

In addition, five 10 kg cartons of each of beef cheeks, lips and hearts as well as 20 kg of beef trimmings were collected at random on four different days. The offals and trim where exposed to different rates of lactic acid spray and/or pasteurization and then tested for the presence of *E. coli*.

What They Learned:

The hide washing treatment greatly reduced the numbers of *E. coli* transferred from the hide to meat of skinned carcasses and changed the strains of *E. coli* present on the hide. However, the small numbers of *E. coli* on the dressed carcasses were the same as numbers previously found on dressed carcasses processed without hide-on washing. This is most likely due to the effectiveness of subsequent carcass decontaminating treatments at the plant. If there was a problem with the carcass pasteurizer, as reportedly occurred in the 2012 recall, the hide wash treatment could provide an additional safeguard.

The internal temperature at the center of a mechanically tenderized steak is not the only indicator of food safety; how often the steaks are flipped is important too. Flipping steaks only once allowed some of the *E. coli* to survive, even if the center of the steak was cooked to a well-done endpoint. Heat doesn't always penetrate the steak at a uniform rate, so not all parts of the steak were heated enough to inactivate all the *E. coli* when the steak was only flipped once. When steaks were flipped twice or more at four-minute intervals, they heated more uniformly, and no *E. coli* survived. More *E. coli* were inactivated in steaks that were flipped twice and cooked medium-rare (63^{o}C) than in steaks that were flipped only once and cooked well-done (71^{o}C).

The study found that spraying lips, cheeks, hearts and trimmings with 5% lactic acid at 0.2 ml per cm^{2} of meat surface eliminated *E. coli* from most of the treated meat.

What it Means:

Washing carcasses before skinning didn't improve the microbial condition of the pasteurized carcass, but may provide an additional safeguard in the event that a carcass pasteurizer goes on the fritz. Mechanically tenderized beef can be prepared safely without cooking it like hamburger. These research results were submitted to Health Canada as they developed the new labels for mechanically tenderized beef. The Health Canada label was finalized and released in August 2014. The new label recommends that mechanically tenderized beef be cooked to a minimum internal temperature of 63°C (medium rare) and flipped at least twice during cooking. Lactic acid continues to be an effective food safety intervention for beef and trim.

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