Non-intact Beef

What is Non-intact Beef?

Non-intact beef products include beef that has been injected/enhanced with solutions, mechanically tenderized by needling, cubing, or pounding devices, or reconstructed into formed entrees (e.g., beef that has been scored to incorporate a marinade, beef that has a solution of proteolytic enzymes applied to or injected into the cut of meat, or a formed and shaped product such as beef gyros). In addition, non-intact beef products include comminuted beef products that are chopped, ground, flaked, or minced (e.g., fresh veal sausage and fabricated beef steak) (U.S. Department of Agriculture, 1999a).

"Whole-muscle, intact beef" means whole-muscle beef that is not injected, mechanically tenderized, reconstructed, or scored and marinated, from which beef steaks may be cut (U.S. Department of Health and Human Services, 2009). Intact beef cuts of muscle include such cuts as steaks, roasts, briskets, and stew beef. In these intact cuts, the interior remains protected from pathogens that may exist on the exterior, so it is highly unlikely that pathogens would migrate below the surface (U.S. Department of Agriculture, 1999b).

Why are non-intact considered a greater health risk?

The primary concern involving non-intact beef is the introduction or translocation of surface pathogens, such as *E. coli* O157:H7, into the deep, internal tissues of the final product. In 1999, the United States Department of Agriculture Food Safety and Inspection Service (USDA-FSIS) clarified that the public health risk for *E. coli* O157:H7 was not limited to ground beef, and it declared *E. coli* O157:H7 as an adulterant in all non-intact beef products.

Evidence of bacterial translocation has been studied through the works of Hajmeer et al. (2000), Heller et al. (2007), Luchansky et al. (2008), and Ray et al. (2010). As expected, these studies show that if the surface is contaminated, it is likely that the interior will be contaminated after needle tenderization, after needle-injection enhancement, and after needle-free-injection enhancement. Heller et al. (2007) even found evidence to show that surface bacteria internalization was greater for moisture-enhanced products than blade-tenderized products.

A study done by Shen et al. (2010) evaluated different cooking methods and their ability to inactivate *E. coli* O157:H7 in non-intact beefsteaks of different thicknesses. Non-intact beefsteaks that were thick (4 cm) in size resulted in greater inactivation of *E. coli* O157:H7 during cooking than did thinner (1.5 cm or 2.5 cm) non-intact beefsteaks cooked to the same internal temperature (65°C, 149°F). This increase in *E. coli* O157:H7 inactivation was attributed to longer cooking times necessary for thick cuts to reach the same internal temperature as the thin cuts. The best cookery method found in the Shen et al. (2010) study was oven-roasting in a standard home oven. The second best cookery method identified by Shen et al. (2010) was pan-broiling followed by double pan-broiling.

Harmful bacteria, if present, should only be on the surface of intact beef products; therefore, surface temperatures during cooking, even to a low degree of doneness, are usually sufficient to kill these surface bacteria, and thus make the product safe to eat. On the flipside, if pathogens are in the interior portions of non-intact beef products, then the internal temperature will determine whether or not the product is safe to eat. Consequently, it has been recommended that non-intact beef products should never be consumed at lower degrees

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of doneness than medium (internal temperature 71°C, 160°F). At this time, USDA-FSIS is considering labeling requirements for non-intact beef products.

What antimicrobial interventions can be applied during the production of non-intact beef?
Research has been conducted on several intervention methods for non-intact beef production. These include trimming the meat surfaces or the use of antimicrobial sprays, dips, and even the addition of an antimicrobial to the enhancement solution.

Echeverry et al. (2009) used a spray cabinet to apply either distilled water (control), lactic acid bacteria, acidified sodium chlorite, or lactic acid to the meat surface. These sprays were applied to strip steaks destined for either mechanical tenderization or moisture enhancement. All interventions reduced the internalization of surface pathogens. It also was hypothesized that the presence of antimicrobials along with a low oxygen environment towards the middle of the steak decreased the survivability of *E. coli* O157:H7 (Echeverry et al., 2009).

Wicklund et al. (2007) investigated the effects of shelf-life enhancers (sodium lactate & sodium diacetate) on the survivability of *E. coli* K12 in needle-injected beef strip steaks. Three enhancement solutions were evaluated. The control solution consisted only of water, salt, and phosphate. The second solution had 3% sodium lactate in addition to the control. The third solution was a combination of 3% sodium lactate and .25% sodium diacetate added to the control solution. The combination, lactate/diacetate solution performed the best at reducing *E. coli* K12 numbers. The control was not successful at reducing *E. coli* K12 counts.

Heller et al. (2007) conducted a study that assessed the effects of surface trimming, hot water spray (82°C, 180°F), 2.5% warm lactic acid spray, 5.0% warm lactic acid spray, and a combination of activated lactoferrin followed by a 5.0% warm lactic acid spray on *E. coli* O157:H7 in blade-tenderized and moisture-enhanced beef round pieces. The 5.0% warm lactic acid spray resulted in the lowest *E. coli* O157:H7 surface counts prior to blade tenderization or moisture enhancement. Trimming resulted in the second fewest surface counts for *E. coli* O157:H7. All other treatments, except the control, had similar, reduced *E. coli* O157:H7 surface counts after application. Therefore, all treatments, other than the control, would likely decrease the amount of internalized bacteria if they were applied before blade tenderization or moisture enhancement.

Castillo et al. (2001) studied the effects of both pre- and post-chill applications of a lactic acid spray to beef carcasses inoculated with *E. coli* O157:H7 and *Salmonella Typhimurium*. Pathogenic counts were reduced following the application of either the pre-chill or the post-chill lactic acid spray. However, optimal reductions for both organisms resulted when both pre- and post-chill sprays were applied.

Additional research is being conducted to determine the efficacy of antimicrobial interventions on chilled subprimals destined for use in non-intact beef production.

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