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Steam pasteurization to reduce bacterial populations on commercially slaughtered beef carcasses

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Abstract

A steam pasteurization system (SPS) has been shown in laboratory and commercial evaluations to effectively reduce bacterial populations on freshly slaughtered beef. Our study evaluate d the bactericidal uniformity of SPS. Samples were collected from the five anatomical locations, one per carcass, 40 samples per location , so that 200 carcasses were evaluated before and 200 after pasteurization. Each carcass was sampled by wiping a 300 c m2 area of the specified location with a moist, sterile sponge. For all locations, the total aerobic plate count (APC) after pasteurization was lower (P#.01). Before pasteurization, the midline was contaminate d most heavily (2.5 log10 cfu/cm2). After pasteurization, the neck and midline had the highest residual APCs (1.3 and 1.1 log 10 cfu/cm2, respectively). For all anatomical locations, the enteric bacteria (E. coli, total coliform, an d Enterobacteriaceae) were lower (P#.01) after than before pasteurization. Only two of 200 pasteurized carcasses ha d E. coli populations greater than 1 cfu/cm2. During pasteurization, steam blankets the carcasses, theoretically providing uniform bacterial destruction. This study demonstrated the effectiveness of SPS for reducing total aerobic and enteric bacterial populations uniformly over five anatomical locations on commercially processed carcasses.

Keywords

Cattlemen's Day, 1997; Kansas Agricultural Experiment Station contribution; no. 97-309-S; Report of progress (Kansas State University. Agricultural Experiment Station and Cooperative Extension Service); 783; Beef; Beef carcasses; Antimicrobial treatment; Steam pasteurization

STEAM PASTEURIZATION TO REDUCE BACTERIAL POPULATIONS ON COMMERCIALLY SLAUGHTERED BEEF CARCASSES

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Summary

A steam pasteurization system (SPS) has been shown in laboratory and commercial evaluations to effectively reduce bacterial populations on freshly slaughtered beef. Our study evaluated the bactericidal uniformity of SPS. Samples were collected from the five anatomical locations, one per carcass, 40 samples per location, so that 200 carcasses were evaluated before and 200 after pasteurization. Each carcass was sampled by wiping a 300 cm^2 area of the specified location with a moist, sterile sponge. For all locations, the total aerobic plate count (APC) after pasteurization was lower ($P \leq .01$). Before pasteurization, the midline was contaminated most heavily (2.5 $\log_{10}$ cfu/cm^2). After pasteurization, the neck and midline had the highest residual APCs (1.3 and 1.1 $\log_{10}$ cfu/cm^2, respectively). For all anatomical locations, the enteric bacteria (*E. coli*, total coliform, and *Enterobacteriaceae*) were lower ($P \leq .01$) after than before pasteurization. Only two of 200 pasteurized carcasses had *E. coli* populations greater than 1 cfu/cm^2. During pasteurization, steam blankets the carcasses, theoretically providing uniform bacterial destruction. This study demonstrated the effectiveness of SPS for reducing total aerobic and enteric bacterial populations uniformly over five anatomical locations on commercially processed carcasses.

(Key Words: Beef Carcasses, Antimicrobial Treatment, Steam Pasteurization.)

Introduction

The microbiological safety of meat products has received increased attention in recent years. The potential for bacteria in meat products to cause illness and death has pushed this issue to the forefront for consumers, regulators, researchers, and the industry.

In July 1996, the USDA-FSIS issued a final rule on "Pathogen Reduction; Hazard Analysis and Critical Control Point (HACCP) Systems". The regulations require changes in the way industry produces meat and meat products. Foremost is the requirement that all slaughter facilities develop HACCP systems. In addition, facilities will be required to implement sanitation standard operating procedures and microbiological testing of carcasses, with standards for generic *E. coli* and *Salmonella* being defined. Antimicrobial treatments during slaughter will likely be necessary to consistently meet these USDA microbial standards. In previous studies, steam pasteurization (Frigoscandia Food Process Systems, Bellevue, WA) effectively reduced both pathogen (laboratory evaluations) and naturally occurring bacterial populations (evaluations on commercial beef carcasses). The current study was designed to verify, in a commercial slaughter facility, the uniformity of bacterial destruction over the entire carcass surface.

Experimental Procedures

A commercial-scale SPS was used after the final carcass wash in a beef slaughter facility. Samples were collected during 2 processing days from randomly selected carcasses immediately before and immediately after pasteurization. Samples were collected from inside round, loin, midline, brisket, and neck. One location was sampled per carcass and 40 carcasses were sampled per location before and after pasteurization (200 carcasses before and 200 others after pasteurization). Samples were collected using the sponge technique required under the new USDA-FSIS regulations for

carcass microbial sampling. Both sides of a single sterile sponge are passed over a 300 cm^2 area. The sponge is premoistened in a sterile stomacher bag containing 30 ml of diluent (.1% peptone diluent with .1% Tween 20) and, after sampling the specified area, is returned to the same diluent. Dilutions were plated on Petrifilm™ plates to enumerate APCs, enteric bacteria *E. coli* (generic), total coliforms, and *Enterobacteriaceae*. Counts were made according to manufacturer's instructions. The minimum detectable count for Petrifilm™ plates was .1 cfu/cm^2. All data were converted to $\log_{10}$ cfu/cm^2. The significance level was set at $P \leq .01$.

Results and Discussion

For all carcass sites, the APC was lower ($P \leq .01$) after than before pasteurization (Table 1). Before pasteurization, the midline had the highest APCs; the loin had the lowest; and the inside round, brisket, and neck were intermediate. After pasteurization, the neck and midline had the highest APCs, approximately 1.2 $\log_{10}$ cfu/cm^2. The inside round, loin, and brisket had similar APCs, approximately .6 $\log_{10}$ cfu/cm^2. Pasteurization reduced bacteria by 65% for inside round, 84% for loin, 96% for midline, 92% for brisket, and 60% for neck.

E. coli was present at low levels before pasteurization and was decreased ($P \leq .01$) at all sites after pasteurization. *E. coli* populations on 189 of 200 carcasses fell within the range <.1 to 1.0 cfu/cm^2 before pasteurization. Some sample counts were as high as 5 cfu/cm^2. After pasteurization, 198 of 200 carcasses fell within the <.1 to 1.0 cfu/cm^2 range, with only two carcasses having *E. coli* populations greater than 1 cfu/cm^2. Very similar results were found for coliform and *Enterobacteriaceae* populations.

In previous steam pasteurization evaluations, samples were collected from one carcass location. Those evaluations demonstrated effective bacterial destruction, but questions remained about the uniformity of bacterial destruction over the entire carcass surface. Our study demonstrated that steam pasteurization reduces bacterial populations uniformly. A large surface area was sampled at each location, and the locations represented the entire carcass. Steam pasteurization can reduce the risk of pathogenic bacterial contamination in beef, but is not a replacement for good sanitation standards, clean and careful slaughter operations, or Good Manufacturing Practices. Steam pasteurization can serve as a critical control point for pathogens during slaughter. Current technology allows automatic tracking of individual carcasses. Additionally, SPS provides assurance to processors that USDA-FSIS microbiological standards will be met continuously.

Table 1. Aerobic Bacterial Populations on Five Beef Carcass Sites before and after Steam Pasteurization

	Before[1]		After	
Carcass Site	Mean ($\log_{10}$ cfu/cm^2)[2]	SEM	Mean ($\log_{10}$ cfu/cm^2)	SEM
Inside round	1.8[c]	.1	.5[a]	.1
Loin	1.4[b]	.1	.6[a]	.1
Midline	2.5[d]	.1	1.1[b]	.1
Brisket	1.8[c]	.1	.7[a]	.1
Neck	1.7[c]	.1	1.3[b]	.1

[1]Before = population immediately before steam pasteurization treatment; After = population immediately after steam pasteurization treatment.
[2]Mean bacterial populations are averages of 40 replicates. SEM=standard error of mean.
[a,b,c,d]Means with different superscripts are different ($P \leq .01$).