MICROBIAL DECONTAMINATION AND WEIGHT OF CARCASS BEEF AS AFFECTED BY AUTOMATED WASHING PRESSURE AND LENGTH OF TIME OF SPRAY[1]

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SUMMARY

Carcasses were obtained from 56 heifers that were fed a corn-corn silage diet to determine the effects of automated washing water spray pressures (SP) of 2412 kilopascal (kPa) or 4134 kPa and chain speeds (CS) of 3.9, 5.9 or 7.9 m/min on microflora and weight changes of carcass beef. Carcass beef sides were weighed before washing, 5 min after washing, 20 h after washing and after storage at 0°C. Carcass sides shrank 1.52 kg after 20 h of storage. This shrinkage was similar among all treatment groups. Washing reduced counts of Enterobacteriaceae counts 1.57 logs (base 10) and counts of aerobic bacteria 0.87 logs. All combinations of SP and CS were similar in effectiveness of reducing microbial counts. Research indicated that automated carcass washing was a useful procedure for reducing bacterial counts on carcass beef without affecting carcass weights.

INTRODUCTION

Carcass beef traditionally have been washed by hand to remove foreign material such as hair, soil particles, and microorganisms that have contaminated the surfaces. Recent research and development of technology have emphasized automated machine washing.

The average shrinkage of carcass beef using good current practices has been reported to be 1.3% at 20 h postmortem. U.S. Federal Meat Inspection Regulations required that carcasses sustain no net increase in weight due to absorption of water during the washing process. There are no available literature on the effects of various automated washing techniques on carcass weights after a 20-h chill.

The objectives of the study reported presently were to determine the effects of nozzle pressure and length of time washed on the microflora and weights of carcass beef at 20-h postmortem.

MATERIALS AND METHODS

Material and design

Carcasses were obtained from 56 heifers that were fed a corn-corn silage diet. Heifers were slaughtered at the U.S. Meat Animal Research Center abattoir, dressed and carcasses split by normal commercial procedures. Carcasses were skinned by knife while on the rail without the use of an automated hide puller. Sides were not shrouded after washing. Sides were assigned randomly to a 2 x 2 split-plot experiment. Sides were washed with 13°C water at slow (3.9 m/min), medium (5.9 m/min) or fast (7.9 m/min) chain speeds (CS) through an automated carcass washer. Sides within carcasses were assigned to low pressure (2412 kilopascal (kPa), at about 284 l/min) or high pressure (4134 kPa, at about 375 l/min) water spray wash (SP). Carcasses were stored in a 0°C cooler during the study.

Washing

Sides passed through a chamber between two spray bars that oscillated on a vertical axis of 45°. The spray bars were opposite each other and each possessed 9 locations for single or double nozzles. Nozzles of opposite bars were 64 cm apart.

Weighing

Carcass sides were weighed before washing, 5 min after washing and 20 h after washing using on-rail scales equipped with a digital weight indicator of 0.05 kg.

Microbiology

A random subsample of equal number of right or left sides from 36 carcasses were used to determine aerobic and Enterobacteriaceae before washing and 20 h after washing. After treatment (20 h postmortem), carcasses were sampled from locations adjacent to location of initial sampling. A sterile template (100 cm^2) was used to define the sample area. Two adjacent samples (total of 200 cm^2) were taken from the round over the Biceps femoris muscle and two adjacent samples (total of 200 cm^2) were taken from the forequarter over the Longissimus muscles adjacent to the first through fifth thoracic vertebrae. Sterile forceps and scalpel were used to remove tissue sample 0.5 cm deep.

Tissue from both 100 cm^2-sample sites (200 cm^2 total) within the forequarter or hindquarter were placed in a stomacher bag containing 100 ml of 0.1% peptone diluent, top sealed by heat, placed in an ice chest and transported 8 h to the laboratory for serial diluting, plating and incubation.

Violet red bile glucose agar with glucose was used to enumerate Enterobacteriaceae. Aerobic microorganisms were enumerated by standard methods or count agar. Samples were plated at appropriate dilutions. Standard plates and violet red bile plates were incubated at 35°C for 48 or 24 h, respectively.

RESULTS AND DISCUSSION

Carcass weight

Interaction of SP by CS was not an important source of variation in side weight or bacterial counts; therefore, subclass means were not presented. Weights of sides were similar at high or low SP at all three CS. Side weights before, 5 min after and after 20 h of storage are given in Table 1. Sides gained ($P<0.001$) 0.83 kg (0.57%) weight during washing. However, the gain in side weight plus an additional ($P<0.01$) 1.52 kg (1.04%) was lost during the 20 h storage period.

Sides washed with high SP gained more ($P<0.001$) than sides washed with low SP (0.941 vs 0.728 kg). After 20 h of storage, weights of sides were

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similar in both treatment groups. Therefore, SP does not have long-term effects on water uptake of sides.

Sides washed with the slow CS gained ($P<0.001$) more weight than sides washed with the medium CS 5 min after washing. Similarly, sides washed with the medium CS were heavier ($P<0.001$) than sides washed with the fast CS. However, after 20 h of storage, sides among the three CS treatments were similar in weight.

Bacterial contamination

Washing reduced ($P<0.001$) Enterobacteriaceae counts by 1.52 $\log_{10}$ colony forming unit (CFU)/200 cm^2 (Table 1). The reduction in aerobic counts was 0.87 $\log_{10}$ CFU/200 cm^2.

Enterobacteriaceae counts were similar for the forequarter and hindquarter. The reduction in Enterobacteriaceae counts was also similar between the two areas. However, aerobic counts were greater ($P<0.051$) in the forequarter than the hindquarter (5.44 vs. 5.29 $\log_{10}$ CFU/200 cm^2). Although this difference was statistically significant, the difference was not likely of practical importance. Washing had a greater ($P<0.002$) impact on the reduction of bacteria in the forequarter than the hindquarter (1.13 vs. 0.68 $\log_{10}$ CFU). The increased reduction in the forequarter cannot be accounted for entirely by the larger initial contamination. Reduction in Enterobacteriaceae counts was not affected by variation in SP.

Results of this study on carcass decontamination indicates that the pressure of water spray between 2412 to 4134 kPa and speed of chain between 3.9 to 7.9 m/min had no residual effect on water uptake of the carcass after 20 h. Also, any combination of these pressures and chain speeds will reduce bacterial contamination.

TABLE 1.
Mean side weights, Enterobacteriaceae and aerobic counts by time periods.

	Time				
Trait	Before	5 min	20 h	Pr>F	Residual SD
Weight, kg	145.53[a]	146.36[b]	144.01[c]	<0.001	0.80
Microbiological data, $\log_{10}$ CFU/200 cm^2:					
Enterobacteriaceae	3.36[a]		1.84[b]	<0.001	0.76
Aerobic	5.80[a]		4.93[b]	<0.001	0.44

[a,b,c]Means within a row with different superscripts are significantly different ($P<0.001$).