Research Note

Microbial Populations on Hides of Grazing Steers in a Forage-Based Production System in Uruguay

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MS 08-098: Received 22 February 2008/Accepted 29 March 2008

ABSTRACT

The objective of the study was to evaluate the microbiological status of hides of grazing steers in a typical forage-based system in Uruguay. The study was conducted on a single farm with samples taken on 3 days during the spring of 2007. Four anatomical hide sites (perineum area, flank, back, and shoulder) of 10 steers were individually swabbed each sampling day at the farm environment (n = 120). Each sample was analyzed by the Laboratorio Tecnológico del Uruguay for aerobic plate counts (APC), total coliform counts (TCC), and Escherichia coli counts (ECC). Mean log values for APC, TCC, and ECC on external animal hide surfaces, across all sampling sites, were 5.52, 1.89, and 1.70 log CFU/cm², respectively. There were no significant differences among bacterial counts from the four hide surface locations. Mean log values for APC, TCC, and ECC were 1.49, 1.15, and 1.12 log CFU/cm² lower, respectively, on sampling day 2 than on sampling day 3. Microbial populations on hides of grazing steers are highly variable and dependent on climatic and environmental conditions. To our knowledge this is the first study published evaluating the hygienic conditions of grazing livestock operations in Uruguay and their potential implications on the red meat chain.

An implicit goal of the Uruguayan red meat chain is to control indicator and pathogenic microorganisms to ensure the wholesomeness of the meat supply. Good manufacturing practices, standard sanitation operation procedures, and hazard analysis and critical control point are generally regarded as effective interventions for controlling and reducing microbial contamination of meat and are applied extensively in Uruguay. However, Bosilevac et al. (4) reported that the number of indicator bacteria on imported boneless beef trims from Uruguay was higher than the bacterial population found in beef trims imported from Australia and New Zealand. Additionally, compared with U.S. trim, Uruguayan trim also had a higher frequency of illness-related serovars of Listeria monocytogenes and hemolytic uremic syndrome–associated Shiga toxin–producing Escherichia coli (4).

Strategic interventions to reduce microbial populations on carcasses are not applied in Uruguayan commercial beef meat plants (i.e., spraying carcasses with organic acids). Therefore, improved carcass hygiene acceptable to Uruguay’s export markets rests more upon attention to prevention practices (i.e., cleanliness of stock entering the slaughtering floor) than with postharvest strategic interventions. It has been well documented that the hide of incoming cattle is a major source of bacterial contamination in beef slaughter plants (1, 5, 13). Transfer of contamination from the hide surface to the carcass can occur by direct contact between the hide and the carcass or by indirect transfer (i.e., by transfer from workers’ hands or clothes or from tools or factory equipment, which have had previous contact with the hide) (3, 14).

Most of the research evaluating microbial loads of cattle hides has been done in finishing-feedlot operations in the United States. It is expected that cattle from feedlots carry more fecal bacteria and less soil organism than those from pastures (16, 17). Recent data reported that pastures offered a susceptible environment to the contamination of cattle hides, while the restricted environment of the feedlot offered fewer chances for contamination, which was confirmed by the visualization of hide from animals in the feedlot, which was cleaner at the moment of slaughter (10).

The general aim of the present study was to add science-based knowledge about the safety of the Uruguayan red meat chain with emphasis on the farm level. The specific objective was to quantify indicator bacteria in hides of finishing grazing steers in a farm during the season of highest animal slaughter rate.

MATERIALS AND METHODS

General. This experiment was carried out between September and October 2007 at the Palo a Pique Research Unit of the INIA-Treinta y Tres Research Station located in eastern Uruguay (latitude, 33°14’S; longitude, 54°15’W). Ten yearling Hereford × Aberdeen Angus steers grazing improved pastures mainly of rye-grass (Lolium multiflorum) and white clover (Trifolium repens) were randomly selected each day of sampling. Sampling collection was done on 17 September, 24 September, and 29 October (sampling days 1, 2, and 3, respectively).
TABLE 1. Microbial populations on hides at sites of sampling

<table>
<thead>
<tr>
<th>Hide site</th>
<th>APC</th>
<th>TCC</th>
<th>ECC</th>
</tr>
</thead>
<tbody>
<tr>
<td>Back</td>
<td>5.68 ± 1.08</td>
<td>1.86 ± 0.81</td>
<td>1.73 ± 0.78</td>
</tr>
<tr>
<td>Flank</td>
<td>5.64 ± 1.33</td>
<td>2.09 ± 1.05</td>
<td>1.88 ± 1.03</td>
</tr>
<tr>
<td>Shoulder</td>
<td>5.27 ± 1.22</td>
<td>1.73 ± 0.80</td>
<td>1.56 ± 0.73</td>
</tr>
<tr>
<td>Perineum</td>
<td>5.47 ± 1.19</td>
<td>1.89 ± 0.87</td>
<td>1.64 ± 0.81</td>
</tr>
</tbody>
</table>

Sampling collection: Individual hide swab samples were taken from the left side of the back, flank, shoulder, and perineum area of each animal by swabbing a 100-cm² area with a sterile sponge (Nasco, Fort Atkinson, Wis.) prehydrated with 15 ml of buffered peptone water. Each site was swabbed 10 times in a horizontal direction and 10 times in a vertical direction. Swabbing with sponges was done aseptically using sterile latex gloves, which in addition to the template (10 by 10 cm), were changed between samplings of different hide sites. An additional 10 ml of buffered peptone water was added to the sponge after sampling to bring the total volume of buffer to 25 ml. The sponges were placed in a labeled Whirl-Pak bag unique to each site of sampling (four sponges per animal). All samples were placed in a cooler with ice and transported the next day to the microbiology section at Laboratorio Tecnológico del Uruguay for microbial analysis.

Microbiological analysis: Each separate sterile bag was analyzed for aerobic plate counts (APC), total coliform counts (TCC), and E. coli counts (ECC). The most-probable-number method was used to determine the level of ECC (9). APC and TCC were determined according to the method described by Downes and Ito (7). Minimum detection limits for both TCC and ECC were 1.88 log CFU/100 cm² (sampling day 1) and 0.88 log CFU/100 cm² (sampling days 2 and 3). Laboratory procedures were adjusted after sampling day 1 in order to lower the minimum detection limit for the next sampling days. TCC and ECC falling below those detection limits were entered as one-half the detection limit expressed in CFU per milliliter and then transformed to log CFU per square centimeter corresponding to 1.57 (sampling day 1) and 0.57 log CFU/100 cm² (sampling days 2 and 3), so that statistical analysis could be performed.

Statistical analysis: The data (TPC, TCC, and ECC) were transformed to log CFU per square centimeter. Statistical analyses were conducted with SAS (SAS Institute Inc., Cary, N.C.) for the main effect of site of samples taken from the hide, blocked by day of sampling. When analysis of variance detected effects (P < 0.05), least-square means were separated using Tukey’s honestly significant difference test. If the sampling block was significant, only sampling days 2 and 3 would be compared because they had the same detection limit.

RESULTS AND DISCUSSION

Values for APC, TCC, and ECC for the four external hide locations on grazing steers are presented in Table 1. Microbial loads did not differ for samples collected from hide surfaces among sample locations (P > 0.05). Mean log values for APC, TCC, and ECC on external animal hide surfaces, across all sampling sites, were 5.52, 1.89, and 1.70 log CFU/cm², respectively. These values are correlated with those found by Bosilevac et al. (4), who reported mean log populations of aerobic bacteria, fecal coliform, and E. coli of 2.8, 2.0, and 1.8 CFU/g, respectively, in Uruguayan boneless beef trim destined to be sold as ground beef in the United States. In the same report, APC for Uruguayan trim ranged as high as 4.85 log CFU/g in 9% of the samples analyzed. Bell (3) reported APC and ECC of 4.92 and 1.92 log CFU/cm², respectively, averaging four hide sites at slaughter (inside hind leg, bung, flap, and brisket) in three export meat plants in New Zealand. In a recent study, Gilbert et al. (8) reported an E. coli concentration average of 2.71 log CFU/cm² on five hide sites (hock, back, brisket, flank, neck) on grain-fed steers. Jardim et al. (10) reported values of hide contamination, before dressing, of 1.27 and 0.86 log CFU/cm², corresponding to coliform and E. coli counts, respectively. Bacon et al. (1) found that initial mean log values for total plate counts, TCC, and ECC on external animal hide surfaces, among eight beef packing plants in the United States, ranged from 8.2 to 12.5, 6.0 to 7.9, and 5.5 to 7.5 log CFU/100 cm², respectively. The main methodological difference between our research and the international research previously cited is that we took the hide samples at the farm while the other studies took them at the abattoir. It is likely that between-animal bacterial transfer during transport or in abattoir lairages occurs directly (animal-to-animal contact) and indirectly (the animal-environment-animal route), so it is expected that microbial contamination of the hide will increase later in the meat chain (2, 6). We suggest that the hide microbiological status of live cattle in their natural environment may be used as an objective tool to assess the hygiene and safety of systems of production within a beef quality assurance program.

Day of sampling had a significant effect (P < 0.05) on mean log values for APC, TCC, and ECC (Table 2). Microbial populations on sampling day 3 (29 October) were significantly greater than microbial populations on sampling day 2 (24 September). Rainfall amounts were 37, 47, and 51 mm within 1 week before sampling days 17 September, 24 September, and 29 October, respectively. Microbial populations on hides of grazing animals can vary depending on climatic and environmental conditions. For example, rainy days may lead to wet and dirtier hides due to muddy environmental conditions in pastoral systems, increasing the microbial contamination. We did not find a correlation between microbial populations on hides of grazing steers and previous rainfall, probably because we did not sample in different seasons. Lahr (11) studied the seasonal variation of microbial populations on beef carcasses and found appreciable differences in the variation of winter versus summer, which could possibly be attributed to cattle that were physically dirtier as a result of having been exposed.
to more precipitation and broader fluctuations in temperature (11). In a baseline survey carried out in Ireland, carcasses with significantly lower total bacterial counts were produced in summer, when cattle hides were cleaner (12, 15).

Results of the present study revealed that the hygienic condition of cattle hides of grazing steers in a Uruguayan farm was good. Even though the study involved a single farm, stocking rate and pasture composition were typical of beef finishing systems in Uruguay. Microbiological contamination on these cattle hides occurred as a result of climatic and environmental conditions. Further research is required to evaluate the effects of climate and/or animal management practices on the microbiological status of hides in pastoral systems.

REFERENCES


