MICROBIOLOGICAL MONITORING OF SWINE SLAUGHTER AND DRESSING OPERATIONS

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BACKGROUND: The requirement for slaughter facilities to implement a Hazard Analysis Critical Control Point (HACCP) plan prompted the microbiological evaluation of different steps in swine slaughter and carcass dressing to determine their effect on the final microbiological count of finished carcasses. Once this has been determined, individual steps can be identified as critical control points and appropriate limits set and monitored during the operation.

OBJECTIVES of this study were to monitor the microbial levels of swine carcass surfaces at three sites on the carcass and at several steps in the dressing operation and determine the effect of changes in the processing steps on the microbial counts of the carcasses.

METHODS: The surfaces of market weight swine (100 kg) were sampled at several steps during the normal slaughter and dressing operations of a local commercial swine processing facility (capacity, 900 per hr). The steps evaluated included scalding, dehairing, polishing, singeing, eviscerating, and chilling. Initial studies involved sampling three carcass sites: ham, belly, and neck or neck flap; during later studies, only the belly region was sampled.

Microbiological Analysis: A 100 cm^2 area, outlined by a sterile 10 x 10 cm metal template, was swabbed with a pre-moistened (10 ml of sterile 0.1% peptone water) Nasco SpeciSponge in a sterile Whirl-Pak bag. Within 30 min of sampling, the bags and their contents were analyzed as follows: the bags were mixed for 2 min in a Stomacher 400 Laboratory mixer and then surface plated on Plate Count Agar (PCA; Difco) for total bacterial numbers, MacConkey Agar (Mac; Difco) for total enterics, and Tryptic Soy Agar (TSA; Difco) overlayed with MacConkey Agar (TSA/Mac; after a two hr period of incubation for recovery of injured enteric bacteria. Plates were counted after 24 hr incubation at 37°C; dilutions were made as needed in 0.1% peptone water. Counts were reported at Log_{10} CFU/cm^2.

RESULTS AND DISCUSSION: As indicated above, initial studies consisted of three sampling sites. However, after the first polishing and singeing steps, total bacterial counts for the three sites were similar, Log_{10} 1.52 CFU/cm^2; similar counts were obtained for total enterics. Based on these initial studies, only the belly region was sampled in subsequent experiments. The singeing process decreased the total bacterial counts by *ca* one log, with a smaller decrease in total enterics. Overlaying TSA with Mac permitted an increased recovery of total enterics, indicating that some of the enterics were injured by the singeing process. This increased recovery of total enterics was observed throughout these studies when the TSA overlaid with Mac was used, suggesting that many of the steps in dressing of swine carcasses can injure bacteria and some procedure in the detection methodology must take this into account when selective media are employed to detect various bacterial groups.

At the facility where this work was done, the sequence of steps for carcass handling after scalding and dehairing are: polishing, first singer, two polishers in sequence, second singer (on either half or full depending on season of the year), and a final polisher/washer; for some studies, this whole procedure was designated as the singeing process. Next, carcasses move to another room where they are eviscerated and inspected. Finally, the eviscerated dressed carcasses are chilled overnight at 1-2°C before further processing into retail fresh cuts or a wide range of prepared meat products. The different steps in carcass handling have the potential both to increase and/or decrease bacterial levels. The first study evaluated the process as a whole, i.e., from initial polisher to chilling of the carcass; these data are present in Table 1. As can be seen from these data, the singeing process substantially reduces the bacterial load on the carcass, the level remains constant during the evisceration, and there is a final decrease during chilling.

The data in Table 1 indicate that the singeing process reduced bacterial levels on swine carcass surfaces. The influence of individual steps in the singeing process on bacterial levels was evaluated (Table 2). These data indicate that the singers, either first and/or second reduced bacterial levels and the two polishers in the middle and the final polisher/washer recontaminated the carcass surfaces. We consulted with the product quality department of the slaughter facility and they indicated that the polishers and washer/polisher are sanitized daily before the start of slaughter; however, because their construction, they are sanitized with all components in place. In addition, the rubber fingers inside the units are difficult to clean and sanitize. Carcasses were sampled for total bacterial numbers at the start of the slaughter day and then very late in the day; these date are presented in Table 3. Two points can be noted in these data: a) in that the total bacterial numbers of the first carcasses of the day increased during passage through the final washer/polisher, the cleaning/sanitizing of the equipment did not appear to be very effective: and b) there was a greater increase in counts on the carcasses during their passage through the equipment later in the day, suggesting that there is a buildup of bacteria inside the equipment and this is transferred to the carcasses.

The data presented indicate that singeing can provide a significant reduction of bacterial levels on carcass surfaces; however, the primary function of singeing is hair removal. It was observed that operating the first singer either at half or full resulted in carcasses with similar levels of bacteria after the final washer/polisher (data not

shown). The next step after the final washer/polisher is manual shaving, i.e., final removal of any stubble and other residue; this operation also represented another opportunity for recontamination of the carcass surface. Microbiological evaluation indicate that manual shaving did not result in any recontamination of carcass surfaces (data not shown). As mentioned above, our studies indicated that similar bacterial levels were present on the ham, belly, and neck/neck flap, so that for most studies, only belly swabs were taken. There was opportunity for the bung dropping operation to contaminate the ham area; this was investigated in a separate study in which the ham area was sampled before and after bung dropping; this study indicated that this operation did not result in any increases in bacterial counts (data not shown).

CONCLUSIONS: The data presented indicate that singeing represents a critical control point in the swine carcass dressing operation. Steps in the carcass dressing operation where recontamination of the carcass surface can occur appear primarily during subsequent polishing operations, with evident so far obtained demonstrating that this equipment can not be effectively sanitized. These studies point to the need to evaluate swine carcass dressing operations based on microbiological criteria rather than on simple visual inspection as in the past.

LITERATURE:

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Table 1. Bacterial levels as Log_{10} CFU/cm^2 on swine carcass bellies at different locations during carcass processing. (n = 20 carcasses)

	Counts on		
Process Sampling Location	PCA	Mac	TSA/Mac
Before Singeing Process	3.31	1.75	2.22
After Singeing Process	1.83	0.66	1.43
Before Chilling	1.88	0.92	1.23
After Chilling	1.03	-0.54	0.65

Table 2. Bacterial levels as Log_{10} CFU/cm^2 on swine carcass bellies at different sites during the singeing process. (n = 10 carcasses)

	Counts on		
Sampling Site	PCA	Mac	TSA/Mac
Before First Singer	2.77	1.39	1.42
After First Singer	0.68	-0.40	0.19
After The Middle Two Polishers	2.24	0.97	1.29
After Second Singer	0.60	0.45	0.34
After Final Washer/Polisher	1.23	0.66	0.91

Table 3. Effect of sampling time during slaughter day on total bacterial numbers on singed swine carcasses during passage through the final washer/polisher. Belly swabs; n = 10 carcasses; counts on PCA as Log_{10} CFU/cm^2.

	Sampling Time*	
Sampling Location	AM	PM
Before Final Washer/Polisher	0.55	-0.07
After Final Washer/Polisher	1.18	1.75

*AM, at start of slaughter; PM, late during slaughter day.