RESTING ON TRANSPORT TRAILER REDUCES SALMONELLA AT HARVEST

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Abstract A potential intervention strategy to reduce the prevalence of Salmonella enterica at harvest was evaluated, which consisted of resting pigs prior to harvest on their transport vehicle, instead of in the abattoir holding pen. Individual fecal samples were collected at the farm and at the abattoir (n= 120 pigs), where half of the pigs were unloaded, and moved to a holding pen, whereas the other half stayed in the transport trailer. After approximately 1.5 hour of resting, both groups were harvested on the same line and samples collected. The overall S. enterica prevalence was higher for pigs held in the abattoir pens (40.7% versus 13.3%, p<0.05). This study demonstrates that resting pigs on the transport vehicle as a method to avoid exposure to contaminated holding pens has the potential to decrease S. enterica levels entering the abattoir.

Introduction Prior to harvest, pigs are held for a period of time to recover from the physiological changes attributed to handling and transport, improve meat quality, and to maintain a constant supply for the harvest line (Fortin, 2002; Warriss et al., 1992). However, we have demonstrated (Hurd et al., 2001; Hurd et al., 2002, Rostagno et al., 2003) that;
1. abattoir holding pens are highly contaminated with S. enterica,
2. swine exposed to a S. enterica-contaminated environment can become rapidly infected, and
3. much of the pre-harvest S. enterica infection in pigs occurs immediately before harvest during this rest period in the contaminated abattoir holding pen.

Consequently, at harvest, the intestinal tract of the pigs and its associated lymph nodes are frequently contaminated or infected with S. enterica and provide the main source from which the bacteria may be spread in the abattoir. The more S. enterica pigs carry into the abattoir greater the risk of equipment and final product contamination.

Intervention strategies to reduce the occurrence of S. enterica infections during the pre-harvest holding period are necessary, in order to reduce the number of pigs carrying the bacteria into the harvest process, consequently reducing the risk of pork and pork products contamination. Therefore, the main objective of this study was to evaluate a potential intervention strategy to reduce the prevalence of S. enterica-positive pigs at harvest, which consisted of resting pigs prior to harvest on their transport vehicle, instead of in the abattoir holding pen. Additionally, a secondary objective of this study was to evaluate the effect of transport on S. enterica prevalence. Many believe that the number of pigs shedding S. enterica will be increased after transportation and its associated stress. However, limited investigations have been conducted on the potential effects of transportation stress on S. enterica shedding in swine (Isaacson et al., 1999; Williams and Newell, 1970). Currently, there is still no conclusive data showing a direct association between transport and increased shedding of S. enterica.

Materials and Methods A total of 120 grower-aged pigs (~25kg) were included in the experiment, divided in 4 replicates (n=30 pigs per replicate). This study was conducted in a very small commercial abattoir (~80 pigs per day) and using young pigs to control several logistic-related variables (e.g., unloading and moving pigs to the holding pen, moving pigs from the holding pen to slaughter, slaughter line speed, cross-contamination, and others) present in large commercial abattoirs that may interfere in the experiment. The small size of the plant allowed for moving the pigs very quickly from the transport trailer to the holding pen, and from the holding pen or transport trailer to the harvest line (~2 minutes).

On the farm, prior to loading, five floor swabs were collected from the transport trailer, and a 1g fecal sample was collected from each pig (directly from the rectum). Pigs were loaded and immediately transported for 3-4 hours. Upon arrival at the abattoir, a 1g fecal sample was again collected, and 15 randomly chosen pigs were unloaded, and moved to a holding pen, whereas the remaining 15 pigs stayed in the transport trailer. Before placement in the holding pen, five floor swabs and one water sample from the drinker were collected to verify pre-existing contamination. After approxi-
mately 1.5 hour of resting, both groups were harvested. Individual samples were collected on the harvest line, and included; distal ileum portion (10cm), cecal contents (10g), and ileocecal lymph node. All samples were individually processed for the isolation and identification of *S. enterica*.

Bacteriological culture methods used included primary enrichment in Tetrathionate broth (24 hours at 37oC), followed by sequential enrichment in Rappaport-Vassiliadis broth containing Novobiocin (24 hours at 42oC), and again in Rappaport-Vassiliadis broth (24 hours at 42oC). From the last enrichment step, isolation was conducted using Xylolose-Lysine-Tergitol-4 (XLT-4) and Brilliant Green Sulfa (BGS) agars (37oC for 24 and 48 hours). Suspect colonies (two per plate) were picked and transferred to Rambach agar plates (37oC for 24 hours) for presumptive identification, and subsequently submitted for serotyping.

*S. enterica* prevalence for the studied treatments (i.e., pre-harvest holding in the abattoir pen, or on the transport trailer) was determined based on each sample type collected, and for any sample type (i.e., prevalence of pigs positive in at least one of the samples collected). Proportions were compared by Chi-square, and the significance level applied was p<0.05.

**Results** Overall, the prevalence of *S. enterica* was significantly lower (p<0.05) for pigs held on the transport trailer than for pigs held in abattoir pens (13.3% versus 40.7%, respectively). The observed difference was consistent in all four repetitions of the experiment.

Incidentally, seven of the 120 pigs (5.8%) were *S. enterica*-positive prior to transportation, and only one pig (0.83%) was positive after transport (p<0.05).

Floor swabs collected from the holding pens were frequently found to be positive for *S. enterica* (95%, 19/20), and a variety of serovars was found prior to the pigs entering for the pre-slaughter resting period. Water samples taken directly from the drinkers available to the animals were also found to be frequently contaminated (50%, 2/4) with *S. enterica*. Only one sample collected from the floor of the transport trailer prior to loading the pigs was positive for *S. enterica* (1/20).

**Discussion** This study emphasizes that the highly contaminated environment of the abattoir lairage facilities (i.e., the pre-slaughter holding pens) is a major source associated with the frequently observed increase in *S. enterica* prevalence at harvest in swine, corroborating previous investigations (Swanenburg et al., 2001a; Rostagno et al., 2003; Larsen et al., 2004), where abattoir holding pens were also found to be highly contaminated with *S. enterica*. By resting pigs on their transport vehicle to avoid the abattoir holding pens, we were able to reduce the prevalence of *S. enterica* at harvest.

One of the objectives of resting pigs prior to harvest is to improve meat quality (Fortin, 2002; Warriss et al., 1992). However, as previously mentioned, this study was conducted using grower-aged pigs as opposed to market weight pigs (i.e., finishing pigs). As a result, it was not possible to evaluate the meat quality impact of resting in the pen versus the trailer. The evaluation of this potential effect should be conducted using market-age pigs. In the other hand, using grower-aged pigs should have no effect on the applicability of the results found regarding *S. enterica* prevalence. The prevalence found after exposure to the contaminated abattoir holding pen is in agreement with the prevalence reported in market-age pigs (Morgan et al., 1987; Swanenburg et al., 2001b; Hurd et al., 2002; Beloeil et al., 2004; Schmidt et al., 2004). Moreover, grower-aged pigs have been frequently used as model to study the pathogenesis of *S. enterica* infection swine (Wood and Pospischil, 1989; Wood and Rose, 1992; Fedorka-Cray et al., 1995; Gray et al., 1996).

Additionally, this study suggests that transportation of the pigs from farm to abattoir has no effect on *S. enterica* prevalence. This evidence is reinforced by the relatively low prevalence found in the group of pigs held on the transport trailer at harvest (13.3%), even though the estimate was based in multiple samples (i.e., distal ileum portion and cecal contents) that would increase the probability of finding positive animals, and consequently, a higher prevalence. Although this type of sampling increases the sensitivity for the identification of positive animals, the prevalence found was comparable to the estimate based on pre- and post-transport fecal samples (1g), which have been demonstrated to have a very low diagnostic sensitivity (Funk et al., 2000). Our results are in contrast somewhat with previous reports of increased prevalence after transport (Williams and Newell, 1970; Isaacson et al., 1999). But they call into question whether transportation of pigs and its associated stress have a significant impact on *S. enterica* prevalence at harvest. However, further investigation is still necessary to more fully understand the complex effects of handling, transporting and mixing of pigs on *S. enterica* prevalence and shedding.
It seems reasonable to assume that intervention measures that aim to reduce the exposure of pigs to *S. enterica* (i.e., reduce the risk of infection) should be most effective in reducing the amount of bacteria entering the abattoir. In this study, we pursued the idea of resting animals on their transport vehicle, based on the observation of a common practice in the poultry industry. Additionally, other alternatives exist which should be evaluated. For instance, cleaning and disinfection of the lairage environment constitute a logical intervention strategy to be considered.

**Conclusions** From the results obtained in this study, it can be concluded that resting pigs on the transport vehicle as a method to avoid exposure to contaminated holding pens has the potential to decrease *S. enterica* levels entering the abattoir.

**References**


