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Transport losses: Causes and solutions

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Introduction

Losses of slaughter weight pigs during transport to the packing plant is not a new issue, however, it is receiving increasing attention because of heightened concerns over the welfare of pigs at this critical stage of the production process. Also, transport losses have a significant negative economic impact on the industry, both in terms of loss of animals and costs for disposal of the carcasses. This paper discusses the incidence and possible causes of losses in the US and describes approaches to minimizing those losses.

Definitions

Transport losses include animals that are dead on arrival at the plant (DOA) and also pigs that have difficulty in walking during unloading, i.e., non-ambulatory animals. Non-ambulatory pigs are also commonly referred to as "downers", "subjects", "suspects", or "slows". Pigs can be non-ambulatory due to some structural defect or injury (referred to as non-ambulatory, injured or NAI), however, some non-ambulatory animals are not injured (so-called non-ambulatory, non-injured or NANI). One definition of NANIs are "pigs that become fatigued without trauma or injury and refuse to walk" (Anderson et al., 2002); such animals are also referred to as fatigued (NPB, 2004).

Incidence of the problem

The Food Safety and Inspection Service (FSIS) collect data at US slaughter plants on the numbers of DOA and these show some interesting historical trends. The incidence of DOA in 2003 was 0.23% of all pigs delivered to plants, however, this was much lower in the early 1990's (around 0.10%), increased substantially from 1994 to 1998 to around 0.30%, and has declined over recent years to current levels. There are no historical statistics on the incidence of non-ambulatory pigs. In field studies, we have observed a wide range of non-ambulatory animals from as low as 0.3% to as high as 1.0% of pigs transported.

Causes of transportation losses

There has been limited investigation of transport losses and, consequently, there is no detailed information on the major causes of this problem. Obviously, trauma and physical injury are involved with non-ambulatory, injured animals. In some studies, we have shown relatively strong correlations (0.6 to 0.9) between the incidence of DOA and the incidence of non-ambulatory, non-injured pigs at the plant, suggesting that these two conditions share some common causes.

Non-ambulatory, non-injured pigs exhibit symptoms characteristic of an acute stress response including open-mouthed breathing (dyspnea), skin discoloration (cyanosis), muscle tremors, abnormal vocalization, and unresponsiveness to stimulation to move. Metabolic responses in such animals include elevated body temperature and changes in acid-base balance characterized by an acidosis (increased blood lactate and reduced blood bicarbonate and pH). Metabolic changes are observed in all pigs subjected to handling and transportation but appear to be extreme in NANI animals. We have been focusing our research efforts on trying to understand the major factors involved in the development of the stress-related NANI pig and on approaches to reducing the incidence of this problem.

Although the major focus of interest has been on stress-related NANI pigs at the slaughter plant, this condition is also observed at the farm during the loading process. In one study, we found that the incidence of stress-related NANIs was very similar at the farm after loading and at the plant after unloading, which suggested that there could be a link between what happened during loading and what was observed on arrival at the plant. In a follow-up investigation, approximately 30% of pigs classified as NANIs after loading onto the truck at the farm were either DOA or classified as NANIs on arrival at the plant; the remaining 70% of pigs were considered normal on arrival at the plant. This suggests that there is a link between the incidence of NANI pigs at the farm and at the plant, however, it also suggests that a large proportion of pigs that became NANIs at the farm will recover during transport (journey times in the study in question were about 3 hours). We have also observed in other studies that a large proportion of stress-related NANI pigs will recover if allowed sufficient time in a low-stress environment.

Prevention of transport losses

Because this problem is stress-related, the obvious approach to reducing the incidence of NANI pigs will involve minimizing the stress on the animal during handling and transportation. In concept, any factor that increases stress on the pig during the loading and transportation process and/or influences the responsiveness of the animal to that stress could influence the incidence of downers. It is possible to induce the fatigued pig condition with one major stressor, particularly by using aggressive handling. However, in many situations, fatigued pigs may be caused by the cumulative effect of many stressors acting in an additive manner. Pigs experience a wide range of potential stressors during the transportation process and we do not fully understand the potential contribution of many of these to the incidence of NANI animals.

At the farm, there are a number of animal-related factors that could influence the animal's responsiveness to stress including: weight, genotype, degree of muscling, health status, structural soundness, stress susceptibility, and previous experience of handling. Environmental factors at the farm that could be associated with the NANI problem include the prevailing climatic conditions (temperature, humidity, barometric pressure), facility design and management, the nutritional program, Paylean usage, and time of feed withdrawal prior to shipping. During loading and transport there are a wide range of factors that could be associated with NANIs including facility design (e.g., aisle widths, ramp height), handling intensity (including use of electric shockers), climatic conditions, time of day loaded and transported, distance pigs are moved prior to loading, mixing of pigs, truck design and management (including ventilation and cooling of pigs in hot weather), stocking density, and time taken for loading, transport, waiting at the plant, and unloading. Many of these factors are potential stressors and as such could contribute to this problem and, where possible, these stressors should be eliminated or at least minimized.

Undoubtedly, a major cause of NANIs can be poor handling during the loading and transportation process. Poor handling of pigs increases the metabolic response of the animal, the extent of metabolic acidosis (Hamilton et al., 2004), and the incidence of NANIs (Anderson et al., 2002).

Moving pigs using low intensity handling (i.e., at their own pace using paddles and moving panels) produces virtually no change in body temperature or measures of blood acid-base status. This suggests that pigs can be handled without producing any major metabolic change. In contrast, aggressive handling, including the use of electric shockers, produces a major metabolic response, resulting in a substantial increase in body temperature and decrease in blood pH, and, also results in a high incidence of fatigued pigs. For example, Anderson et al. (2002) found that 11 out of 90 aggressively handled pigs became fatigued compared to none of the animals that were handled gently.

Two animal factors that have been associated with transport losses are genotype and slaughter weight. There is a widely held belief that the lean, heavy-muscled lines of pig are more susceptible to the stress of loading and transportation and will show a higher incidence of dead and fatigued animals. The HAL-1843 mutation of the Halothane (or Stress) gene has historically been responsible for a significant proportion of transport losses. Selection against this mutation has been routinely practiced in most populations for a number of years and it is claimed that most commercial genetic lines used in the US are free of the mutation. However, given the relatively low incidence for transport losses, the involvement of the Hal-1843 mutation cannot be ruled out and warrants further investigation. In addition, Marr et al. (2004) showed that some pigs that were free of the HAL-1843 mutation responded negatively to halothane anesthesia and were also more susceptible to becoming downers when subjected to aggressive handling. Also, Ritter et al. (2005) showed a difference between sire lines for changes in rectal temperature and blood-acid base balance during handling. On this basis, there appears to be a strong likelihood of a significant genetic involvement in transport losses, although, which genes and alleles are involved has yet to be established.

It has been suggested that losses during transportation could be greater in heavier pigs and there have been substantial increases in slaughter weights in the US industry over recent years. Heavier pigs could show a greater metabolic response and increase in rectal temperature in response to handling, which would predispose them to death during transport or to becoming NANIs. However, we found no effect of live weight across the range likely to be used in most commercial situations in the US (104 to 128 kg) on blood pH or rectal temperature in pigs subjected to an aggressive handling model (Hamilton et al., 2004).

A major transportation factor that is associated with transport losses is the stocking density on the truck. In a recent study, Ritter et al. (2004) showed that total transport losses (deads and non-ambulatory) were more than two times higher at low (0.4 m^2/pig) compared to high (0.5 m^2/pig) floor spaces on the truck (0.88 vs. 0.36% total losses, respectively). Interestingly, European studies have suggested that giving high levels of floor space (>0.5 m^2/100 kg live weight) may not be beneficial because the pigs

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are thrown around more during the journey and have more room to fight. Further research is needed to establish the optimum floor space during transport to minimize losses under US conditions; this optimum may well vary with season and may be greater in hot weather than at cooler times of the year.

The design of the handling and loading facilities and of the truck are critical components of a low-stress handling system. Commonly observed problems on commercial operations include narrow aisles, steep ramp inclines, and barriers to pig movement such as shadows, and changes in flooring or penning. Some barns have been designed with very narrow aisles (<0.7 meters) to maximize the floor space available for the pigs. There are two major pig handling problems associated with narrow aisles; firstly, pigs get wedged together, resulting in high levels of stress and, also, some pigs will "somersault" and come back down the aisle in the wrong direction, making it much more difficult and stressful to move a group of animals from the pen to the truck. Anderson et al. (2002) have shown that wedging of pigs can be a major predisposing factor to the fatigued pig condition. Increasing aisle width to at least 1 meter will virtually eliminate the problems outlined above.

Other factors that could increase the stress levels experienced by the pig and predispose to greater losses during transport are the distance the pigs are moved from the pen to the truck and the mixing of pigs from different pens in the same compartment on the truck. Modern swine barns are relatively long (up to 100 meters) and often load out from one end of the building only, resulting in pigs being moved relatively long distances during loading. In addition, it is normal to mix pigs from different pens on the truck, potentially leading to high levels of fighting. The development and adoption of autosort technology and the associated use of very large groups of pigs can reduce the distance pigs need to be moved to the truck and eliminate the need for pigs to be mixed during transport, which should, in theory, lead to reduced transport losses.

One area that has received relatively little attention is how best to prepare the pigs for the transportation process. In many situations, particularly wean-to-finish production, pigs have limited contact with people and little or no experience of being handled. It has been proposed that approaches such as regularly allowing pigs out of the pen and also having caretakers routinely walking the pens during the production period will result in the loading and transportation process being easier and less stressful for the animal. However, this has not been validated in research studies.

Conclusions

Losses during transport in slaughter pigs are important economically and from a welfare perspective. Major factors that will lead to the reduction of transport losses include selection of appropriate people to handle the pigs and training in appropriate handling techniques, providing incentives to workers for improved performance, facility and truck designs that allow animals to move easily, and better preparation of the animals for the stresses associated with transportation. Finally, further research is needed to fully understand the causes of transport losses and to identify approaches to minimizing these.

References

Anderson DB, Ivers, DJ, Benjamin ME, Gonyou HW, Jay Jones D, Miller KD, McGuffey R, Armstrong TA, Mowrey DH, Richardson LF, Seneriz R, Wagner JR, Watkins LE, Zimmermann AG. *Physiological responses of market hogs to different handling practices*. 2002. American Association of Swine Veterinarians, Kansas City, MO.

Hamilton DN, Ellis M, Bertol TM, Miller KD. Effects of handling intensity and live weight on blood acid-base status in finishing pigs. 2004. *J. Anim.Sci*. 82:2405-2409.

Hamilton DN, Ellis M, Bressner GE, Wolter BF, Jones DJ, Watkins LE. Relationships between environmental conditions on trucks and losses during transport to slaughter in finishing pigs. 2003. *J.Anim.Sci*. 81: (2) 53(Abstr).

Ivers DJ, Richardson LF, Jones DJ, Watkins LE, Miller KD, Wagner JR, Seneriz R, Zimmerman AG, Bowers KA, Anderson DB. Physiological comparison of downer and non-downer pigs following transportation and unloading at a packing plant. 2002. *J.Anim.Sci*. 80;2:39(Abstr).

Marr, AL, Allison, CP, Berry, NL, Anderson, DB, Ivers, DJ, Richardson, LF, Keffaber, K, Johnson, RC, Doumit, ME. Impact of halothane sensitivity on mobility status and blood metabolites of HAL-1843-free pigs following an aggressive handling model. 2004. *J.Anim.Sci*. 82;2:33(Abstr).

Murray AC, Johnson CP. Impact of the halothane gene on muscle quality and pre-slaughter deaths in Western Canadian pigs. 1998. *Can.J.Anim.Sci*. 78:543-548.

NPB 2004. *Trucker Quality Assurance Handbook*. National Pork Board, Des Moines, IA.

Ritter MJ, Ellis M, Bertelsen CR, Brinkman J, Peterson BA, Schlipf JM, and Wolter BF. 2005. The effect of sire line, floor space allowance in the barn, and gender on handling characteristics and stress responses in finishing pigs. Paper to be presented at the *Annual Meeting of the American Society of Animal Sciences*.

Ritter MJ., Ellis M., Brinkmann, J., DeDecker JM., Kocher ME., Keffaber K., Peterson BA., Schlipf JM. and Wolter BF. 2004. The effects of stocking density during transport of slaughter weight pigs on the incidence of dead and non-ambulatory pigs at the packing plant. *Proceedings of the 57th Annual Reciprocal Meat Conference*. 57:8 (Abstr.).