Evaluation of temperature conditions in trucks during transport of market pigs to slaughter in four seasons

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Previous research at PSC has shown there is significant variation in conditions (temperature and humidity) among different compartments in trucks transporting market pigs. This study examined conditions in truck compartments in greater depth by measuring temperature and humidity variation during transport of market pigs throughout the year. Pigs were transported from a commercial farm in Saskatchewan to a packing plant on a weekly basis, involving approximately 7.5 hours of travel. This report describes the variable conditions observed during transport in different seasons, with pigs transported in the 'belly', upper-front and middle-front compartments encountering the least favourable conditions.

Background

Transportation of pigs to slaughter involves economic losses due to deaths, 'suspect' animals on arrival at the processing plant and reduced meat quality, and raises concerns regarding the welfare of pigs. Death losses in market pigs during transport in Canada range from 0.05 to 0.17%, accounting for approximately 16,000 pigs per year, with an additional 0.10 to 0.20% of animals becoming non-ambulatory during transport. These losses are seasonal, with higher losses reported in summer, and vary among compartments within a truck. Previous research at PSC has demonstrated significant variation in temperature and humidity conditions between different compartments on trailers. In this study, which began in January 2010 and was completed in March 2011, we examined temperature and humidity conditions on a commercial tri-axle trailer to examine how conditions vary in compartments during different seasons of the year.

Experimental approach

Animals used in this study were market pigs weighing approximately 115 kg. The animals included a mixture of males (barrows) and females, and were assembled from multiple pens. All animals were from a single commercial farm in Saskatchewan. The trials were conducted on a weekly basis, beginning January 08, 2010, and completed in March 07, 2011. The pigs were generally loaded early in the morning (approximately 4:00 am) and travelled for approximately 7.5 h, arriving at the packing plant approximately at 12 noon. A single tri-axle livestock trailer was used for the study. Compartments in the upper deck were numbered from 1, at the front, to 4, at the back. The middle deck was numbered from 5, at the front, to 8, at the back. Compartments in the pot-belly were numbered 9, at the front, and 10, at the back. Pigs were loaded in 8 of the 10 compartments. Compartments 6 and 7 were not used due to availability of pigs and load limitations. Loading density was approximately 0.41 m^2/pig (0.36 m^2/100 kg). Temperature and relative humidity within the compartments were monitored using data logging devices (iButtons). The devices were programmed to record data at 5 minute

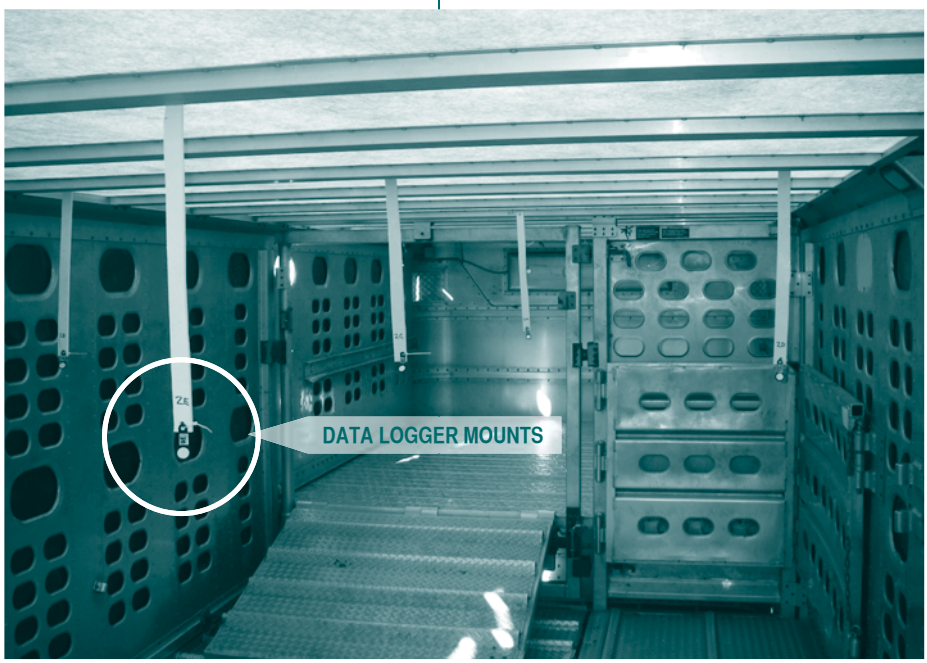

Figure 1. Placement of data loggers in the trailer (compartment 3).

intervals. Five data loggers were mounted in each compartment, with all loggers placed 130 cm above the floor to standardize the measures between compartments. The devices were suspended from the ceiling on strips of hard plastic (Figure 1); one was mounted in the centre of each compartment and the remaining four were placed 15 cm from the centre of each wall. Two data loggers were also mounted on the truck side mirrors outside the trailer to monitor ambient conditions.

To compare seasonal variation in transport conditions, four seasons were identified based on ambient temperatures at the time of departure (approximately 5:00 a.m.). Season 1 included trips where the ambient temperature was below minus 10°C (extreme cold), Season 2 included ambient temperatures from 0oc to - 10°C (moderate cold), Season 3 included ambient temperatures from 0°C to 10°C (mild, above zero), and Season 4 included ambient temperatures above 10°C (extreme, above zero). Temperatures were determined for each compartment at the time the truck left the farm (departure), and as the truck was travelling to the packing plant. The number of truck loads per each season and the average ambient temperatures (outdoors) at the time of departure from farm, during travelling, and on arrival at the packing plant are presented in Table 1.

Table 1. Average and range of ambient temperatures (outdoors) encountered at the time of departure from the farm, during transport, and on arrival at the packing plant.

	Season			
	1 (< - 10°C)	2 (- 10°C - 0°C)	3 (0°C - 10°C)	4 (> 10°C)
Number of truck loads of pigs	12	8	16	6
Average ambient temperature at the time of departure from the farm (°C)	-19.4	-6.3	4.4	14.7
Range	-31.1 – -10.5	- 8.9 – -0.1	-0.6 - 10.4	11.7 - 18.2
Average ambient temperature during transportation of pigs (°C)	-19.1	- 6.4	8.6	18.6
Range	-19.5 – -7.0	- 7.2 - 7.7	3.6 - 24.2	18.2 - 30.9
Average ambient temperature at the time of arrival at the packing plant (°C)	-13.8	-1.4	13.2	24.7
Range	-28.9 – -10.5	- 11.2 – -1.2	- 0.6 - 17.3	15.0 - 22.0

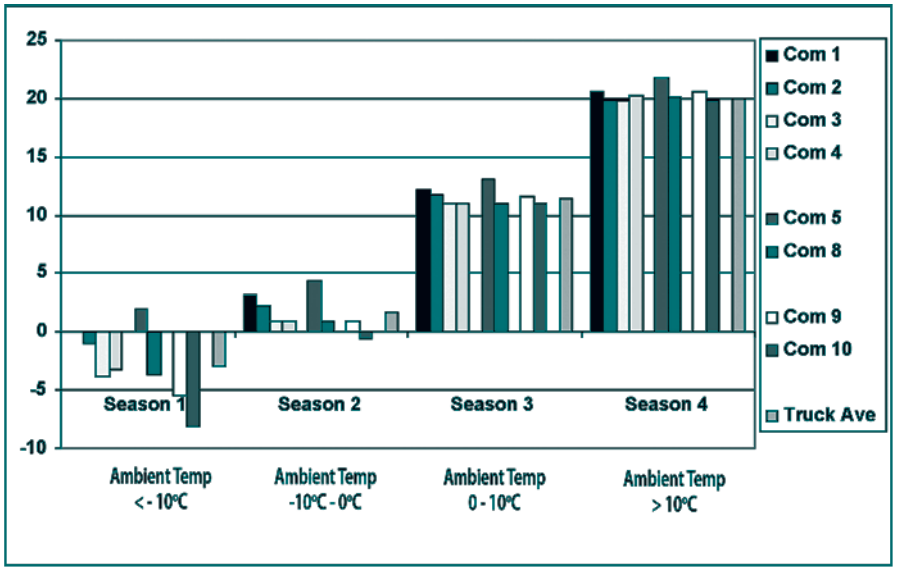

Figure 2. Truck temperatures during transportation in four seasons.

The results:

The average temperature within each compartment of the truck at the time of departure is presented in Table 2. In all four seasons, temperatures at departure were lowest in the 'belly' compared to other compartments, and highest in the middle-front and upper-front compartments.

During transport, compartments in the middle-front (compartment 5) and upper-front deck (compartments 1 and 2) had higher temperatures compared to others in all four seasons (Table 2 and Figure 2). These compartments had relatively poor ventilation, as the front of the trailer was solid. Compartment 5 is also immediately above the truck drive wheels and transmission, which will be dissipating heat. Furthermore, previous research indicates that cool air enters at the back of the truck during transport, becoming warmer as it moves towards the front of the truck. Together these factors may have contributed to higher temperatures in the front compartments.

In extreme cold conditions (Season 1), compartments in the 'belly' had the lowest temperatures compared to others, and a similar trend was found in Season 2 (Table 2 and Figure 2). These compartments had higher ceiling heights as the compartments immediately above them were not used. Thus, extreme cold conditions in the 'belly' compartments was likely due to cool air entering from the back of the truck and the absence of pigs above them to warm the ceilings.

The Bottom Line:

Pigs are exposed to variable temperatures during transport, with pigs transported in 'belly' compartments encountering lower than average temperatures, and those in upper-front and middle-front compartments encountering elevated temperatures. The effects of different boarding and insulation treatments on transport conditions during winter were examined, but further analysis is needed to determine their effectiveness. The results of these studies will provide important information for improving conditions during transport, and for the direction of future research.

(Evaluation of Temp ... continued on page 5)

behaviour to alleviate competition, and use thermoregulatory behaviour to avoid cold or extreme heat. If the animal is unable to express these behaviours, it will become frustrated and stressed. It may be able to express the behaviours, but be ineffective in coping because a critical part of the environment is missing, for example, a wallow (cooling device) in hot conditions. In some cases, the behaviour may be harmful, such as when attempts to root for food result in injury. The natural approach considers how well the system accommodates the responses of the animal. Its motto can be expressed as 'fit the farm to the animal, not the animal to the farm'. Freedom of movement is a critical component of the natural approach to animal welfare.

While these three approaches- 'functional', 'affective states' and 'natural'- can be used separately, when used alone they run the risk of jeopardizing other components of animal welfare. Rather than placing our emphasis on any one component of animal welfare, we should look for systems that overlap (see Figure 1), and meet a comprehensive definition: a system in which an animal functions well, in which positive feelings outweigh negative, and in which it can express its natural behaviour in an effective manner.

This is the first in a series of articles using animal welfare science to address production issues in modern pork production.

Table 1. The Five Freedoms defined by the Farm Animal Welfare Council (FAWC,1979).

Freedom from thirst and hunger	by ready access to fresh water and a diet to maintain full health and vigour
Freedom from discomfort	by providing an appropriate environment including shelter and a comfortable resting area
Freedom from pain, injury, and disease	by prevention or rapid diagnosis and treatment
Freedom to express normal behavior	by providing sufficient space, proper facilities and company of the animal's own kind
Freedom from fear and distress	by ensuring conditions and treatment which avoid mental suffering

This comprehensive definition of animal welfare meets the approval of most members of society. It is also evident in the Five Freedoms (Table 1), which are accepted guidelines for animal well-being used by many animal production organizations. In the current revision process for Canadian Codes of Practice, for pigs and other species, the mandate includes this comprehensive approach. The challenge to modern producers will be to achieve these goals in a production system that is also efficient and profitable.

From a research perspective, the challenge to scientists at the Prairie Swine Centre is to identify management practices that can optimize animal welfare while at the same time maintaining or improving productivity, efficiency and profitability. This is the first in a series of articles using animal welfare science to address production issues in modern pork production.

References:

Fraser, D. 2008, Understanding Animal Welfare: the science in its cultural context. Wiley-Blackwell, Hoboken, NJ.

Farm Animal Welfare Council, 1979. See http://www.fawc.org.uk/freedoms.htm

a 'drop-off' in the middle of the day. Comparing these results with other studies suggests that the younger pigs were limited in the number of feeder spaces, and had to shift eating from the normal peak periods to the less intensive mid-day period.

(Evaluation of Temp ... continued from page 3)

Table 2. Average temperatures within truck compartments at the time of departure from the farm and during transport to the packing plant.

	Compartment									
	1	2	3	4	5	8	9	10	S.E.	P
Departure										
Season 1 (< - 10°C)	20.7^{a}	18.5^{ab}	16.7^{ab}	14.4^{b}	14.9^{b}	8.9^{c}	3.5^{d}	3.9^{d}	1.7	<0.01
Season 2 (- 10°C - 0°C)	18.9^{a}	15.9^{ab}	15.5^{ab}	14.4^{ab}	16.8^{ab}	11.4^{bc}	7.6^{c}	8.4^{c}	2.2	<0.01
Season 3 (0°C - 10°C)	16.3^{a}	13.5^{b}	13.6^{b}	13.1^{b}	17.9^{a}	13.4^{b}	11.2^{c}	12.4^{bc}	0.6	<0.01
Season 4 (> 10°C)	20.1	18.0	17.8	18.4	22.7	19.2	17.6	17.6	1.2	0.44
During transport										
Season 1 (< - 10°C)	0.1	-1.0	-3.8	-3.2	2.0	-3.6	-5.4	-8.1	1.4	<0.01
Season 2 (- 10°C - 0°C)	3.2	2.6	1.0	0.9	4.3	0.9	0.9	-0.6	1.3	0.15
Season 3 (0°C - 10°C)	12.2	11.7	11.0	10.9	13.0	10.9	11.5	10.9	1.2	0.88
Season 4 (> 10°C)	20.5	19.9	19.9	20.3	21.7	20.2	20.5	19.8	1.2	0.44