

# Evaluation of Temperature Conditions in Trucks During Transport of Market Pigs to Slaughter in Four Seasons

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## SUMMARY

Previous research at PSC has shown significant variation in conditions (temperature and humidity) among different compartments on trucks transporting market pigs. This study examined conditions in truck compartments in greater depth by measuring temperature and humidity variation during transportation 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. Pigs were exposed to variable temperatures during transport in different seasons with pigs transported in the 'belly', upper-front and middle-front compartments encountering the least favourable conditions.

## INTRODUCTION

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 important concerns regarding the welfare of pigs. Death losses. In market pigs during transport in Canada are reported to 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. Transport 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.

*"Pigs transported in the "belly" compartments encounter lower than average temperatures and those in the upper-front and middle-front compartments encounter elevated temperatures"*



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

## EXPERIMENTAL PROCEDURES

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 at approximately 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<sup>2</sup>/pig (0.36 m<sup>2</sup>/100 kg). Temperatures and relative humidity within the compartments were monitored using data logging devices (iButtons). The devices were programmed to record data at 5 minute intervals. Five data loggers were mounted in each compartment, with all loggers placed 130 cm above the floor to standardize the measures between compartments. They were positioned in the centre of the compartment, and 15 cm from the centre of each wall of the compartment, and were suspended from the ceiling on strips of hard plastic (Figure 1). Two data loggers were mounted outside the trailer on the truck side mirrors to monitor ambient conditions.

To study the seasonal variations in temperature among truck compartments, 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 0°C 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 (approximately 2.8 hour period) to the packing plant. The number of truck loads per each season, and the average and range of ambient temperatures (outdoors) encountered on departure from farm, during travelling, and on arrival at the packing plant are presented in Table 1.

## RESULTS AND DISCUSSION

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

During transport, compartments in the middle-front (compartment 5) and upper-front deck (compartments 1 and 2) had higher tem-

**Table 1.** Average and Range of Ambient Temperatures (outdoors) encountered at the time of departure from farm, during transport, and at the time of arrival at the packing plant.

	Season			
	1 (<10°C)	2 (10°C to 0°C)	3 (0°C to <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 to -10.5	-8.9 to -0.1	-0.6 to 10.4	11.7 to 18.2
Average ambient temperature during transportation of pigs (°C)	-19.1	-6.4	8.6	18.6
Range	-19.5 to -7.0	-7.2 to -7.7	3.6 to 24.2	18.2-30.9
Average ambient temperature at time of arrival at the packing plant (°C)	-13.8	-1.4	13.2	24.7
Range	-28.9 to -10.5	-11.2 to -1.2	-0.6 to 17.3	15.0 to 22.0

peratures compared to others of the truck in all four seasons (Table 2 and Figure 2). These compartments have relatively poor ventilation, as the front of the trailer is 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. All of these factors may have contributed to higher temperatures in front compartments.

In extreme cold conditions (Season 1), compartments in the 'belly' had the lowest temperatures compared to others, and a similar trend was observed in Season 2 (Table 2 and Figure 2). These compartments had higher ceiling heights as the compartments immediately above them were not loaded. Cool air entering from the back of the truck and cooling these two compartments and pigs above them to warm the ceilings are likely reasons for this.

## CONCLUSION

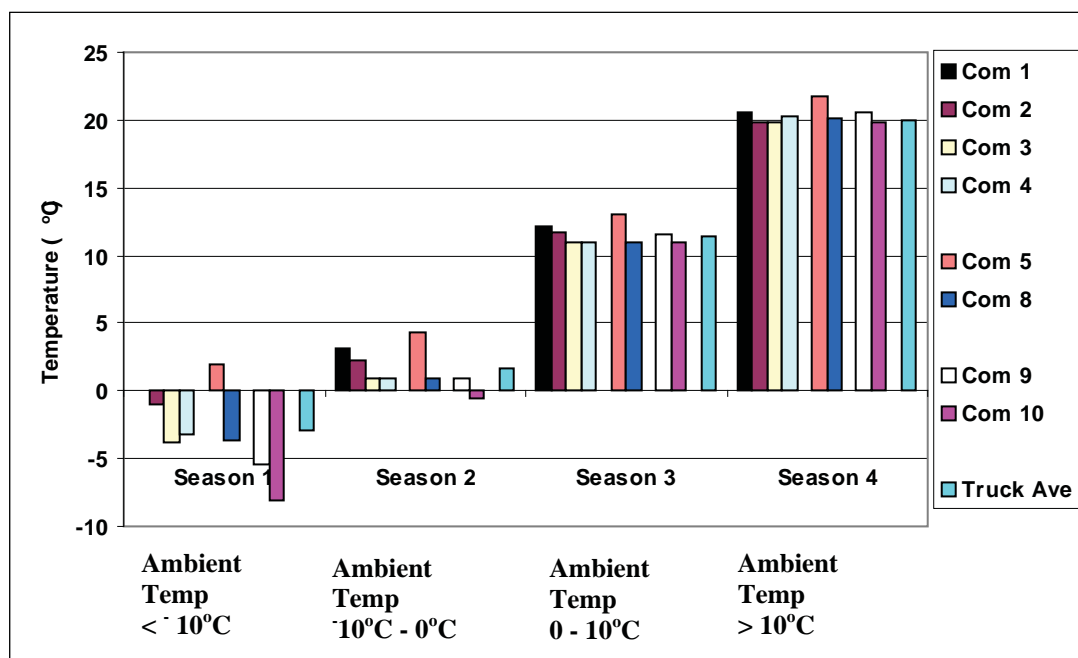
Pigs were exposed to variable temperatures during transport in different seasons with pigs transported in 'belly' compartments encountering lower than average temperatures, and those in upper-front and middle-front compartments encountering elevated temperatures. Further analysis will examine the effects of different boarding and insulation treatments during winter on transport conditions. The results of this study will provide important information on the conditions experienced by pigs during transport and identify methods for improving transport conditions.

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

	Compartment									S.E.	F
	1	2	3	4	5	8	9	10			
Season 1 (<10°C)	20.7 <sup>a</sup>	18.5 <sup>ab</sup>	16.7 <sup>ab</sup>	14.4 <sup>b</sup>	14.9 <sup>b</sup>	8.9 <sup>c</sup>	3.5 <sup>d</sup>	3.9 <sup>d</sup>	1.7	<0.01	
Season 2 (10°C to 0°C)	18.9 <sup>a</sup>	15.9 <sup>ab</sup>	15.5 <sup>ab</sup>	14.4 <sup>ab</sup>	16.8 <sup>ab</sup>	11.4 <sup>bc</sup>	7.6 <sup>c</sup>	8.4 <sup>c</sup>	2.2	<0.01	
Season 3 (0°C to <10°C)	16.3 <sup>a</sup>	13.5 <sup>b</sup>	13.6 <sup>b</sup>	13.1 <sup>b</sup>	17.9 <sup>a</sup>	13.4 <sup>b</sup>	11.2 <sup>c</sup>	12.4 <sup>bc</sup>	0.6	<0.01	
Season 4 (>10°C)	20.1	18.0	17.8	18.4	22.7	19.2	17.6	17.6	12	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 to 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 to <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	



**Figure 2.** Truck temperatures during transportation in four seasons.