Available online at www.sciencedirect.com
ScienceDirect
Livestock Science 116 (2008) 338 – 341
LIVESTOCK SCIENCE
www.elsevier.com/locate/livsci

Short communication

Novelty causes elevated heart rate and immune changes in pigs exposed to handling, alleys, and ramps

C.R.G. Lewis [1], L.E. Hulbert, J.J. McGlone *

Pork Industry Institute, Department of Animal and Food Sciences, Texas Tech University, Lubbock, 79409-2141, USA

Received 18 January 2008; received in revised form 29 February 2008; accepted 29 February 2008

Abstract

The objective of the present research was to quantify the cardiovascular and physiological responses in pigs subjected to novel alleys and ramps. Ten test subject pigs were selected per treatment. The first (trained) group were trained to navigate a course including a ramp. Testing was daily for seven days. Once training was completed, the trained and control (naïve) groups were exposed to a fixed course, the course and ramp (both up and down) while heart rates, time, handling difficulty, and blood were collected to determine the innate responses. Heart rates of trained pigs were reduced significantly ($P=0.003$) compared to naïve pigs travelling the same course. Both handling ease and handling time were significantly improved for the trained pigs ($P=0.03$ and $P=0.01$ respectively) compared to naïve pigs. Blood immune measures indicated reduced stress among trained pigs who had lower neutrophil numbers ($P=0.04$) and lower total and average phagocytosis ($P=0.001$ and $P=0.02$) compared with naïve pigs. This study demonstrated that the exposure of pigs to a novel environment clearly causes a mild physiological response. Pigs are not inherently stressed by alleys and ramps, but rather novel experiences cause handling problems and a stress response and minimal training can reduce the stress experience for the pig.

Keywords: Pig; Handling; Novel environment; Stress

1. Introduction

Economic losses related to the handling of pigs are well known throughout the industry (Tarrant, 1989). Handling effects on pig stress are complicated and few studies have quantified stress responses in common handling situations.

In times of stress, the HPA (hypothalamic pituitary-adrena axis) axis is activated and glucocorticoids are released into the blood of the pig. Stress also causes changes in measures of the immune system (McGlone et al., 1993; Morrow-Tesch et al., 1994; Hicks et al., 1998; Salak-Johnson and McGlone, 2007). Alongside endocrine and immune responses to stress, stressed animals may undergo physiological changes such as increased heart and respiration rates that lead to an increase in body core temperature. Heart rate can be determined by use of telemetry to obtain undisturbed responses within experimental groups (Von Borell, 2001; Von Borell et al., 2007; Marchant-Forde et al., 2003a,b).

* Corresponding author. Tel.: +1 806 742 2805x246; fax: +1 806 742 4003.
E-mail address: john.mcglone@ttu.edu (J.J. McGlone).
[1] Present address: Department of Genetics and Genomics, Roslin Institute, Roslin, Midlothian, EH25 9RE, Scotland.

1871-1413/$ - see front matter
doi:10.1016/j.livsci.2008.02.014

The main hypothesis for this study was that when pigs are exposed to a novel environment they would have a higher heart rate and an overall stress response compared with those pigs that were habitualized with the environment. We also sought to determine if minimal training to remove novelty would reduce the stress experience for pigs destined for transport to slaughter. The ultimate goal is to reduce or eliminate stress-induced problems with pig losses during transportation and handling.

2. Materials and methods

This experiment was approved by the Texas Tech University Animal Care and Use Committee. The subjects chosen for experimentation were progeny of the Camborough 22 (C-22), PIC USA breeding stock located at the Texas Tech University swine unit. Pigs were randomly selected within established penned groups from a standard indoor finishing barn and assigned to a treatment, and they remained in the pens for the duration of the experiment. For inclusion within this study the individual pigs needed to be at or over 90 kg live weight and not treated with medications or feed additives. All pigs were naïve to handling in the manner of this study.

The novel environment for all test pigs was a course and a ramp. The ramp was custom built for this project and had a 35° angle to the peak (which is a similar angle to many ramps within livestock trailers), with 4 ft long sides and had cleats (small steps spaced inches apart) to aid the pig during ascent and descent. The ramp was also built wide enough so that more than three pigs could cross the ramp at one time. The ramp was placed in a standard handling course that was constructed within the finishing barn that consisted of two straight hallways, five turns, and movement through a confined area. The handling course is similar to the one described in detail by McGlone et al. (2004) but with a ramp added. Ten pigs were exposed to the ramp once a day for seven days. After the seven days of training, all the animals (trained and naïve) were run through the model on the eighth day in two groups of three and one of four per treatment.

Cardiovascular data were collected using the Polar Sports 610 ir heart rate monitor and T61 coded transmitter (Polar Electro, Oy, Finland). This heart rate monitor was attached to three of the pigs within an individual group so each treatment group had data from nine animals overall. The device consists of an electrode belt with a transmitter and a watch receiver. The receiver stored the data transmitted from the belt. The receiver was set to receive heart rate data every 5 s. The belt was fit around the pig's chest, using a canvas and velcro constructed belt strap with a pouch to contain the monitor (Southwest Canvas, Lubbock, TX). A lubricant gel was applied to the sensors so that a good connection was maintained with the pig's skin. During collection of data, pigs were gently prompted away from other curious pigs to prevent other pigs from removing the belt or receiver or otherwise interfering with the device. However, some pig-device interference resulted in lost information.

After collection of a full data set, the belt and receiver were removed from the pigs, and the receivers were taken to a computer outfitted with the Polar downloading receiver. Data were then downloaded.

Data were grouped into a mean heart rate for pre-handling, during exposure to the ramp, and post-exposure periods. Other handling-associated measures taken from the experiment were time to navigate the ramp, and a subjective handling score. The handler based the score on a four point scale where one is minimal difficulty to move and four is very difficult to move requiring active the use of a livestock board.

Blood was drawn over lithium heparin immediately after experimentation so that immune measures associated with stress could be analyzed. The pigs were restrained using a nose loop via a process previously established as minimally stressful to the pig (Lewis et al., 2005). The blood was collected from the jugular vein using heparinized tubes, spun and separated, and analyzed using the Cell Dyne instrument (Abbott Labs, Santa Clara, CA) to count total leukocytes and determine leukocyte differentials. The plasma was then frozen until cortisol was measured using a Coat-a-Count cortisol kit (Diagnostic products, Los Angeles, CA) following the manufactures protocol.

Neutrophil chemotaxis, chemokinesis, and phagocytosis were determined on whole blood by methods previously described by McGlone et al. (1993) and Hulbert and McGlone (2006). Briefly, for chemotaxis and chemokinesis a modified Boyden chamber (Neuro Probe, Cabin John, MD) was used to measure the migration of neutrophils toward media (chemokinesis) or toward 10^{-8} M of recombinant human complement fragment, C5a, (chemotaxis). The number of beads phagocytised was counted as 0, 1, 2, 3, 4, 5 or 6 or more. The percentage of cells that phagocytyzed at least one bead and the average numbers of beads phagocytyzed were determined.

Table 1
Effects of training or naivety on pig physiological measures when exposed to a novel handling facility

Measure	Trained	Naïve	SE	*P*-value
Heart rate (bpm)	151.2	172.6	4.16	0.003
Handling score (1–5 scale)	1.33	3.33	0.32	0.01
Time to complete course (min)	1.26	3.97	0.63	0.03
Weight of pigs (lb)	221.3	217.0	9.20	0.75
White blood cells (no/mL $\times 10^{-3}$)	12.28	18.63	1.94	0.08
Neutrophils (no/mL $\times 10^{-3}$)	3.08	4.48	0.34	0.04
Lymphocytes (no/mL $\times 10^{-3}$)	7.75	12.3	1.60	0.11
Monocytes (no/mL $\times 10^{-3}$)	0.66	1.00	0.11	0.11
Eosinophils (no/mL $\times 10^{-3}$)	0.64	0.72	0.11	0.60
Basophils (no/mL $\times 10^{-3}$)	0.15	0.15	0.03	0.91
Neutrophil:lymphocyte ratio	0.48	0.40	0.07	0.46
Chemokinesis (no. cells 5 fields/well)	173.6	144.5	25.7	0.47
Chemotaxis (no. cells 5 fields/well)	242.4	306.1	52.5	0.44
Phagocytosis (% cells)	40.4	58.8	1.79	0.001
Average Phagocytosis rate (no. beads engulfed/100 cells)	4.46	7.24	0.55	0.02