

# Impact of Stressing a Pen Mate on Physiological Responses of Growing Pigs

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## Story in Brief

Crossbred barrows and gilts ( $n = 36$ ), weighing  $36.5 \pm 4.6$  lb, were used to test the effects of stressing a pen mate on the physiological responses of growing pigs. Pigs were randomly allotted to 6 groups, after stratifying according to gender, litter origin, and BW. Dominance order was determined within each group, and 1 to 3 d prior to the stress treatment the most and least dominant pigs within a group were fitted with indwelling catheters in the vena cava. Over 3 d, groups were: 1) isolated from audile and visual contact with stressed pigs in a separate room (non-stressed control); 2) separated from visual contact with stressed pigs by a curtain; or 3) allowed to maintain audile and visual contact with stressed pigs. Blood samples were collected 30, 15, and 0 min before exposure to the stressor (snout-snare) treatment and again at 1, 2, 3, 4, 5, 7.5, 10, 15, 20, 25, and 30 min after stressor application. Serum cortisol and plasma glucose, lactate, and nonesterified fatty acids (NEFA) concentrations were measured. There were no treatment  $\times$  sampling time interactions ( $P > 0.17$ ) for concentrations of cortisol, glucose, lactate or NEFA, and these metabolites were not affected by treatment ( $P > 0.42$ ). Humeral measures of the stress response were not affected by visual and/or audile contact with pen mates undergoing a stressful event.

## Introduction

The amount of stress that pigs encounter is a problem impacting the swine industry. This stress may be caused by many factors including overcrowding, separation from cohorts, or any number of environmental factors such as heat stress. Stress dramatically impacts nutritional intake and growth rate (Wellock et al., 2003). Therefore, swine producers should be conscious of the stress their animals are under so that they can maximize profitability.

Research in the area of stress would benefit swine producers by potentially providing scientific evidence that pigs do stress over the well being of other pigs. This evidence would encourage swine producers to minimize the stress levels on their animals. Reduced stress for the pigs may improve feed utilization and allow the pigs to come closer to reaching their full genetic potential for growth and efficiency and thus be more profitable for the producer.

The purpose of this research was to determine how indirect stress (stress of a fellow pen mate) affects pigs. The stress status of the pigs was measured by changes in blood metabolites. Therefore, the objectives of this study were to determine what the effects of indirect stress are on pigs.

## Experimental Procedures

During this 25 d study, the project utilized thirty-six, 35 to 40 d old pigs (approximately 44 lb, 18 barrows and 18 gilts), from the University of Arkansas Division of Agriculture swine herd. Pigs were blocked by gender then divided into 6 groups of 6 animals after stratification for litter origin, and weight (3 groups of barrows and 3 groups of gilts). Pigs were housed in an off-site nursery facility, with 2 separate rooms (Fig. 1). In 1 of the rooms, a curtain was hung, dividing it into 2 equal sections; thus producing 3 visually isolated areas. Two pens (13.7 x 3.9 ft) in each of the 3 areas were used for housing the 6 groups (within each area there was always 1 group of each gender). These large pens had completely slatted

floors and were equipped with a 5-hole nursery feeder and 4 nipple waterers. From d 1 to 25, pigs were offered ad libitum access to a typical grower diet (Table 1) that was formulated to meet all current NRC (1998) requirements, and pigs were given unlimited access to water.

Every third day, groups were rotated among pens in order to become acclimated to human contact and pen rotation. Additionally, dominance order was determined within the groups by using an index of displacements equation (number of times a pig displaced another pig/(number of times a pig displaced another pig + number of times a pig was displaced)). Pigs were monitored for 30 min/d, on d 8, 9, 10, 14, 15, and 16. After social rank was determined, the most and least dominant pigs in each group were chosen for cannulation and the middle ranked pigs were used for snaring (the stressor).

On d 20 and 21, 2 pigs/group received cannulas in the vena cava. Pigs were anesthetized with isoflurane and nitrous oxide gas and then implanted with 90 cm Tygon Microbore tubing (i.d. 1.27 mm). Sodium citrate was infused into the tubing, acting as an anticoagulant. Pigs were then housed individually after surgery (Fig. 1). However, these pigs were placed back in their respective areas and were allowed visual and snout contact with their cohorts. Panels, with vertical bars with 2-in gaps between bars, separated pens.

On d 23, 24, and 25, the stress treatments were imposed. Treatments were 1) no contact with snared pigs (control), 2) audile contact with snared pigs, and 3) audile and visual contact with snared pigs. On these days, blood samples were taken from the cannulated pigs at -30, -15, and 0 min before snaring of their cohorts. Starting immediately after time 0, 2 pigs (1/pen) in the audile and visual treatment area (Area A, Fig. 1) were snared for a duration of 2 min. Blood samples were taken from the cannulated pigs at 1, 2, 3, 4, 5, 7.5, 10, 15, 20, 25, and 30 min after snaring began. At each sampling time, 4 ml of blood were drawn and then split and stored in plain tubes (1 ml) for serum collection and tubes containing sodium fluoride (3 ml) for collection of plasma. Samples were stored on ice prior to centrifugation at  $2,100 \times g$  for 20 min for separation of serum or plasma. Serum was used to analyze cortisol

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concentrations by radioimmunoassay (DPC, Los Angeles, Calif.). Plasma was analyzed for glucose, NEFA, and lactate concentrations with colorimetric procedures.

This experiment was arranged as 3 x 3 Latin square design, replicated within gender, in which all groups were exposed to all 3 treatments over the 3 d. Data were analyzed using the PROC MIXED procedure in SAS (SAS Inst., Inc., Cary, N.C.). The repeated statement was used with the SP(POW) covariance structure. The subject was group within day. The experimental unit was group. The fixed effects were gender, treatment, day, replicate, gender x treatment, time, and time x treatment. Means were separated with an F-protected t-test.

## Results and Discussion

There was not a treatment x sampling time interaction ( $P = 0.55$ ) for concentrations of cortisol (Fig. 2). Additionally, cortisol concentrations were not affected by stress treatment ( $P = 0.43$ ) or gender ( $P = 0.57$ ). Regardless of treatment, cortisol concentrations were greater 10 min after stress treatment began and lowest 1, 4, 5, 25, and 30 min after stress treatment began (time effect,  $P = 0.03$ ). Also, serum cortisol levels tended to be greater ( $P = 0.10$ ) on d 2 vs. d 1 of the experiment with d 3 being intermediate (data not shown). Cortisol, shown to dramatically increase during a stress event, is the classic stress-indicating hormone (Widmaier, 2006). Stress events, such as regrouping pigs, cause a stress response indicated by increased concentrations of cortisol (Coutellier et al., 2007). In the current study, no samples contained cortisol concentrations that would indicate a high level of stress. Thus, the vocalizations and/or sight of a snared cohort did not elicit a classic stress response in other pigs.

Apple et al. (2005) reported an increase in glucose concentrations when finishing pigs were exposed to a stressor (transportation). Increased concentrations of plasma glucose would be expected in stressed animals due to mobilization of glycogen resulting in the release of glucose into the circulation (Prunier et al., 2005). In this study, there was no treatment x sampling time interaction ( $P = 0.46$ ) for circulating concentrations of glucose (Fig. 3). Furthermore, glucose concentrations were not affected by stress treatment ( $P = 0.97$ ) or gender ( $P = 0.78$ ). Plasma glucose concentrations were also similar ( $P = 0.70$ ) before and during stressor treatment. Lastly, plasma glucose levels were similar ( $P = 0.62$ ) across the 3 d of the stress treatments.

Plasma NEFA concentrations (Fig. 4) had no treatment x sampling time interaction ( $P = 0.17$ ) and were not affected by stress treatment ( $P = 0.91$ ) or gender ( $P = 0.48$ ). Plasma NEFA concentrations were also similar before and during stressor treatment ( $P = 0.55$ ). However, NEFA concentrations measured on d 3 were greater ( $P = 0.01$ ) than concentrations measured on d 1 and 2 of the stressor treatments (107 vs. 92 and 97 mmol/L for d 3, 1, and 2, respectively). In pigs, plasma NEFA concentrations initially decrease during stressful events. In transported pigs, plasma NEFA

concentrations at 30 min after the onset of transportation were lower than nonstressed pigs (Apple et al., 2005). With longer term stress, plasma NEFA concentrations rise (after 120 min of transportation, Apple et al., 2005). This is due to increased lipolysis and may explain the increase we observed on d 3 in the cannulated pigs. However, the absence of an increase in the concentration of plasma NEFA during stressor treatment indicates there was not a stress response due to snaring the cohort.

Plasma lactate concentrations (Fig. 5) had no treatment x time interaction ( $P = 0.96$ ) and were not affected by stress treatment ( $P = 0.60$ ). However, gender ( $P = 0.003$ ) did have an impact on lactate concentrations (0.67 vs. 0.83 mmol/L, for females and males, respectively). Plasma lactate concentrations were comparable before and during stressor treatment ( $P = 0.75$ ). An increase in plasma lactate could indicate catecholamine-initiated glycogenolysis, a possible characterization of stress response (Apple et al., 2005). However, there were no plasma lactate concentration differences to report that would indicate a stress response in this study.

## Implications

Swine undergoing stressful events have been shown to suffer from reduced average daily gain, and reduced meat quality. Knowing what causes stress would help reduce stress. Results of the current study suggest that humeral measures of the stress response are not affected by visual and/or audible contact with pen mates undergoing a stressful event.

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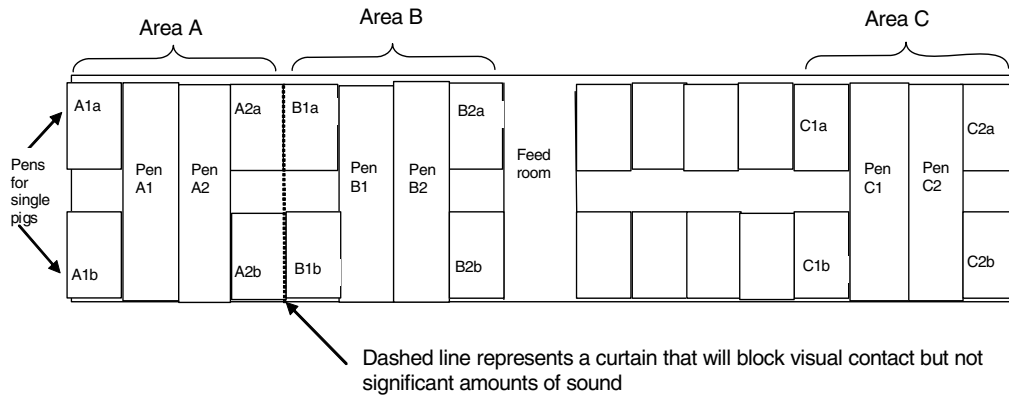
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**Table 1. Diet composition (as fed basis)**

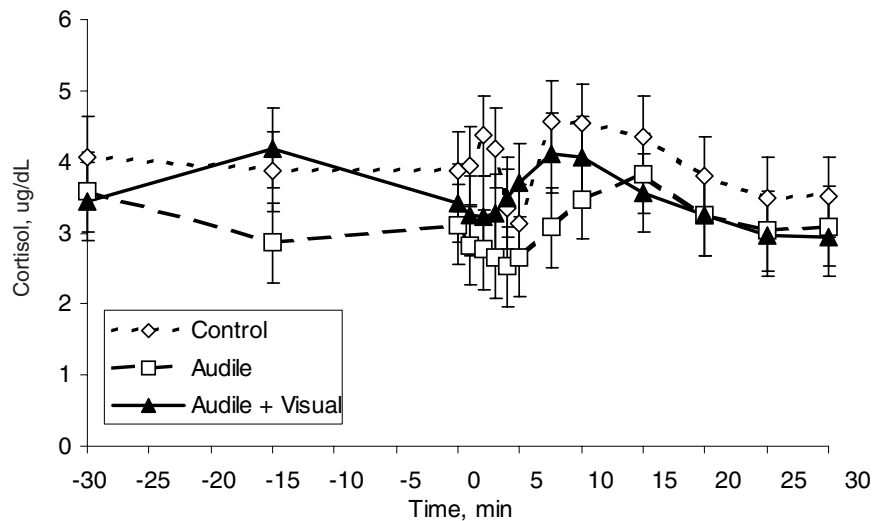
Item	%
Yellow corn	65.95
Soybean meal, 48% CP	28.86
Fat, yellow grease	2.30
Ethoxyquin	0.03
Lysine HCL	0.15
Threonine	0.02
Methionine	0.02
Tylan-40	0.05
Mineral premix <sup>1</sup>	0.10
Vitamin premix <sup>2</sup>	0.15
Monocalcium phosphate	0.75
Calcium carbonate	0.92
Salt	0.50

<sup>1</sup> Mineral levels meet or exceed NRC (1998) recommendations.

<sup>2</sup> Vitamin levels meet or exceed NRC (1998) recommendations.



**Fig. 1. Off-site nursery design (not to scale)**



**Fig. 2. Serum cortisol concentrations before and after stress treatment (stress treatment x time interaction, P = 0.55).**

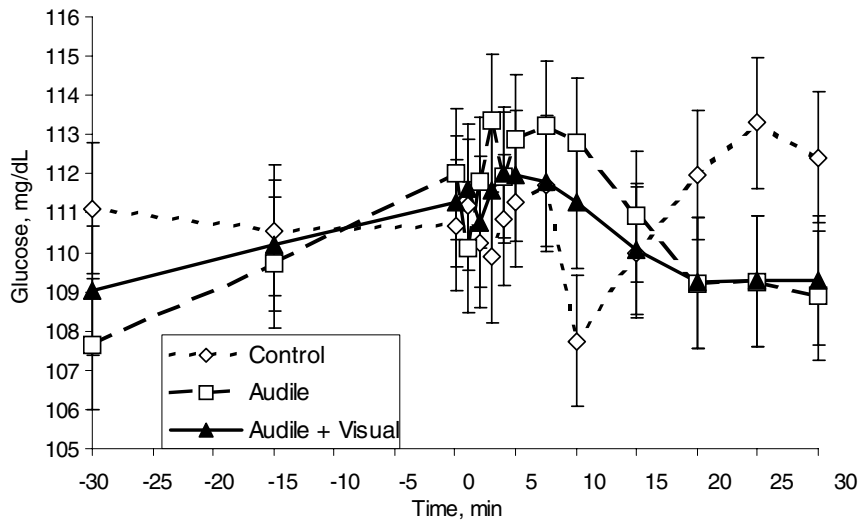


Fig. 3. Plasma glucose concentrations before and after stress treatment (stress treatment x time interaction,  $P = 0.46$ ).

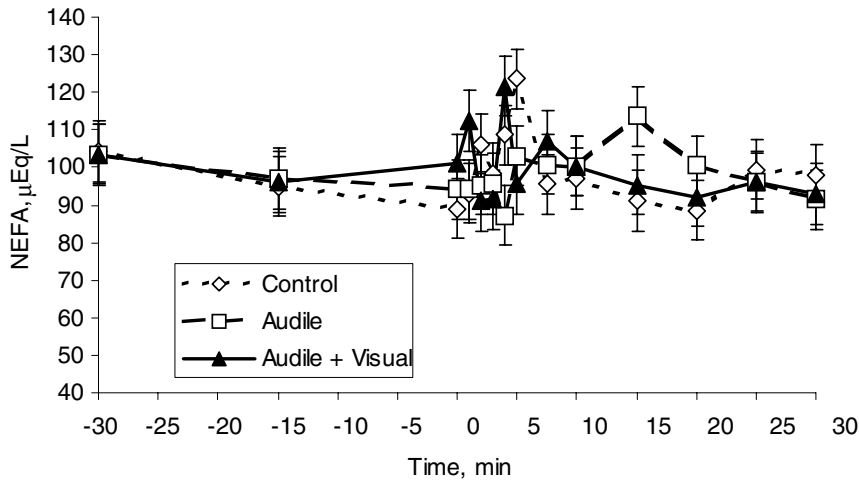


Fig. 4. Plasma NEFA concentrations before and after stress treatment (stress treatment x time interaction,  $P = 0.17$ ).

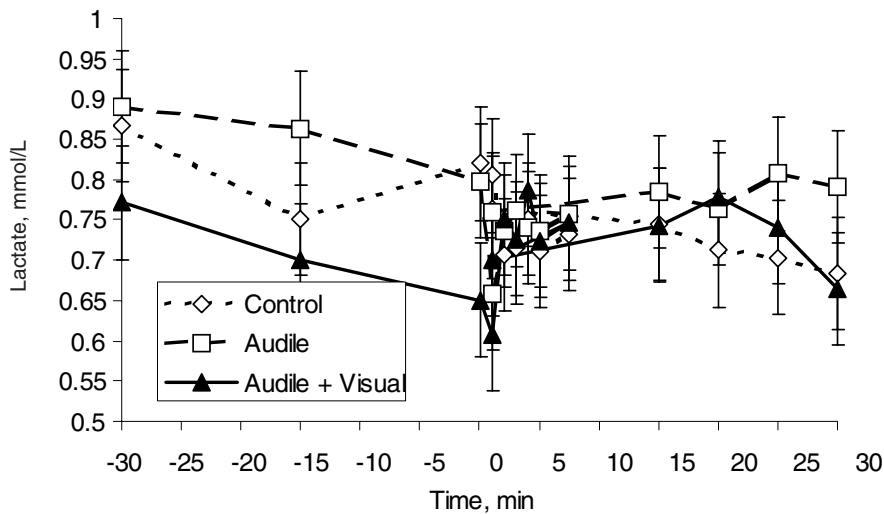


Fig. 5. Plasma lactate concentrations before and after stress treatment (stress treatment x time interaction,  $P = 0.96$ ).