Sponsors

University of Minnesota
College of Veterinary Medicine

College of Food, Agricultural and Natural Resource Sciences

Extension Service

Swine Center

Thank you to **IDEXX Laboratories** for their financial support to reproduce the conference proceeding book.

Production Assistant
Janice Storebo

Formatting
Tina Smith

CD-ROM
David Brown

Logo Design
Ruth Cronje, and Jan Swanson;
based on the original design by Dr. Robert Dunlop

Relationship between a pig's temperament and handling experience, and measures of stress at slaughter and meat quality

Jennifer A Brown[1]; Ira B Mandell[1]; Cornelius FM deLange[1]; Peter Purslow[2]; J. Andrew Robinson[1]; James EJ Squires[1]; Tina M Widowski[1]
[1]Department of Animal and Poultry Science, University of Guelph, Guelph, Ontario; [2]Department of Food Science, University of Guelph, Guelph, Ontario

Background

Pigs often experience stress at transport and handling, and this can result in losses to producers and meat packers due to deaths, downgrading and meat quality problems such as PSE pork.[1,2] Previous studies on methods for reducing stress have frequently produced conflicting results, and/or significant individual variation. Two factors contributing to individual variation are the temperament and experience of animals. However, our current understanding of how temperament and experience influence the stress response and meat quality is limited. A better understanding of these factors could help to improve the quality and consistency of pork and reduce losses by selecting for animals better suited to modern production conditions, or development of management tools that better prepare animals for transport and handling at slaughter.

The stress response results when an animal perceives that its wellbeing is threatened, and triggers physiological changes that prepare the animal to 'fight or flee'. However, because of individual differences in perception and physiology, a situation that is stressful for one animal may not be stressful for another. Porcine stress syndrome (PSS) is a classic example of how physiology can affect stress. Unfortunately perception is more difficult to measure, as it involves complex processes in the central nervous system. Animals show individual differences in temperament or personality, which are influenced by genetics and experience, and result in differences in traits such as activity, aggression, or fearfulness. Research also indicates that different animals have distinct responses to stress, depending on their temperament. Some show an 'active' behavioural response to challenging situations, while others show a more 'passive' coping response.[3] While most of the research on the stress response and 'coping styles' has been done in rodents, some studies have been done in pigs and results are thus far inconclusive.[4]

On the other hand, the effect of handling experience on reducing fear in pigs has been well documented.[5] Repeated exposure to humans and handling results in a habituation response, which can be measures by the animals' willingness to approach a human. The beneficial effects of pen walking of pigs during finishing to familiarize pigs with humans and handling, and reduce fear, have been promoted for several years.[6] In a previous study, we found that walking pens for as little as 30 seconds per week resulted in a measurable improvement in handling at slaughter.[7]

While some research has been done on temperament and handling experience in pigs, very little is known about how these factors interact to affect the stress response and meat quality. If individual variation in temperament and handling is important in controlling meat quality, it is fair to ask- why do we know so little about it? One reason is that it is more complicated and labor intensive to collect data on individual animals versus groups. Another reason is that developments in statistical modeling and computers have only recently made it feasible to analyze effects of individual variation in these studies. Difficulties in measuring animal temperament and lack of understanding in this area have been another factor. However, recent animal research using human models of personality holds promise for understanding relationships between temperament, experience and the stress response.[3]

This study was performed on two commercial farms and at a commercial abattoir. Our objective was to determine whether the temperament of pigs and frequent handling during the finishing phase affect meat quality parameters which are known to be influenced by stress.

Materials and methods

Two commercial farms participated in the study, representing extremes in meat quality; Farm 1 was previously found to have poorer performance on meat quality parameters than Farm 2 (eg. drip loss, loin pH, loin lightness and tenderness). On each farm, 36 pens of pigs (20-25 pigs/pen) were randomly divided into three treatments; 1) Control, 2) Pen Walking, and 3) Crowd Treatment.

The two handling treatments (Pen Walk and Crowd Treatment) were administered during the final 8 weeks before shipping, while Control pigs received no handling outside of regular management procedures. In the Pen Walking treatment, a handler with a handling board entered the pen twice per week and walked around for approximately 50 seconds, encouraging pigs to move out of the way. In the Crowd Treatment, a handler entered the pen twice per week and used a board to crowd pigs towards one end of the pen, and then used a paddle to move pigs through

the opening between the board and pen wall. The Crowd Treatment took approximately 2 minutes to complete. The goal of this treatment was to approximate handling which occurs in the crowd pen at the abattoir. At the end of the 8 week treatment phase, approximately 25 pigs were selected from each treatment (80 per farm) for meat quality analysis. On each farm, pigs were slaughtered on three separate days.

Before shipping, the temperament of individual pigs was determined using an 'open door test' (ODT). For the ODT, the pen door was opened and the time taken for pigs to leave the pen was recorded. Pigs which voluntarily left within the first minute were classified as 'Bold', those which left in under three minutes were 'Intermediate', and pigs which remained in the pen after three minutes were 'Shy'. Only 'Bold' and 'Shy' pigs were selected for meat quality analysis. The pigs were given ear tags and individual tattoos to allow carcass identification after slaughter. Meat quality measures were collected on loin and ham from a total of 160 pigs.

Results

Not surprisingly, meat quality differed significantly between the two farms, and handling treatments also showed variable effects. For each farm, data was collected on three days, and days also affected results, in part due to differences in ambient temperature. Table 1 compares the mean results of four meat quality variables between the two farms. Significant farm differences were found for loin color and ham shear ($P < 0.001$), and there was a tendency for loin pH to differ between farms ($P < 0.1$). Commercial farms were used in order to obtain 'real world' values for handling and stress, however use of commercial farms also meant compromising on control of some factors to comply with existing farm management and minimize biosecurity risk. Genetics varied between farms, with one group being YorkshireXDuroc and the other, Landrace. Feed and farm management also varied, as did resting times between trucking and slaughter.

Loin color is an important meat quality trait that is affected by stress. Acute stress before slaughter initiates anaerobic metabolism and the buildup of lactic acid, and can result in PSE pork. Color is measured using a lightness score (L*), with higher L* values indicating a less-desirable product. Average loin color on Farm 1 was lighter than that on Farm 2, and on Farm 1, loin color varied significantly between different temperaments within treatments. This effect was most notable in the Crowd Treatment, where 'Bold' pigs had better loin color (lower L* value) than 'Shy' pigs (see Figure 1). Farm 2 showed very consistent loin color, however there were no significant effects due to handling treatment or temperament (Figure 1).

Drip loss is another significant meat quality trait that is influenced by stress, and which causes significant losses to meat packers and the swine industry. Handling treatments had significant effects on drip loss, particularly on Farm 2, where Pen Walking resulted in a significant reduction in ham drip loss (see Figure 2). On Farm 2, drip loss in ham averaged 6.4% in Pen Walked pigs, compared to 8.2 and 7.6%, respectively, in Control and Crowd Treatment pigs. On Farm 1, temperament had different effects in Control versus handled pigs: in Control animals, 'Bold' pigs had higher drip loss than 'Shy' pigs. Conversely, in handled animals (Crowd Treatment), 'Bold' pigs had lower drip loss than 'Shy' pigs (Figure 2). A possible explanation may lie in animal personality research, which suggests that 'Bolder' animals are more active, but also more prone to stress due to fear, as may be the case in Control animals.[3] However, repeated exposure to handling such as the Crowd Treatment is expected to reduce fear and result in 'Bold' animals remaining active, but experiencing reduced stress at handling.

Table 1: Comparison of meat quality in ham and loin on study Farms (mean ± sd)

Variable	Farm 1	Farm 2
Ham lightness (L*)	45.55 ± 2.6	45.51 ± 3.4
Loin lightness (L*)	48.80 ± 2.7 **	46.76 ± 2.3 **
Ham drip loss (%)	7.08 ± 1.6	7.30 ± 1.8
Loin drip loss (%)	6.98 ± 1.6	6.85 ± 1.7
Ham shear[1]	2.79 ± 0.5**	3.46 ± 0.8**
Loin shear[1]	3.63 ± 0.9	4.24 ± 1.6
Ham pH (final)	5.52 ± 0.1	5.66 ± 0.1
Loin pH (final)	5.48 ± 0.1*	5.64 ± 0.1*

[1] Warner-Bratzler shear force, a measure of tenderness.

**Significant farm difference, t statistic ($P < 0.001$). *Trend for farm difference, t-statistic ($P < 0.10$).

Handling treatments were also found to affect the final pH of meat. As mentioned previously, acute stress at slaughter results in the metabolic production of lactic acid. The resulting buildup of lactic acid in pork produces a low ultimate pH, as measured 24 hours after slaughter. This trait is also typically associated with PSE pork. On Farm 1, handled pigs (especially those receiving the Crowd Treatment) showed a higher pH in 'Bold' animals. Unfortunately the handled animals had, on average, lower pH than Controls, due primarily to the low pH in 'Shy' animals (see Fig. 3). In contrast to this, handling treatments on Farm 2 resulted in higher final pH, with Pen Walked pigs having an average ham pH (final) of 5.71, compared to 5.62 in Controls ($P < 0.05$). We speculate that this difference in treatment effect (i.e. reduced pH with Pen Walking on Farm 1 versus increased pH on Farm 2), may have been due to nutritional differences or differences in lairage times between farms.

Figure 1: Loin Colour for Farm 1 and Farm 2 (ls means +/-std err). Lower L* scores are desirable. Different subscripts differ significantly ($P < 0.05$).

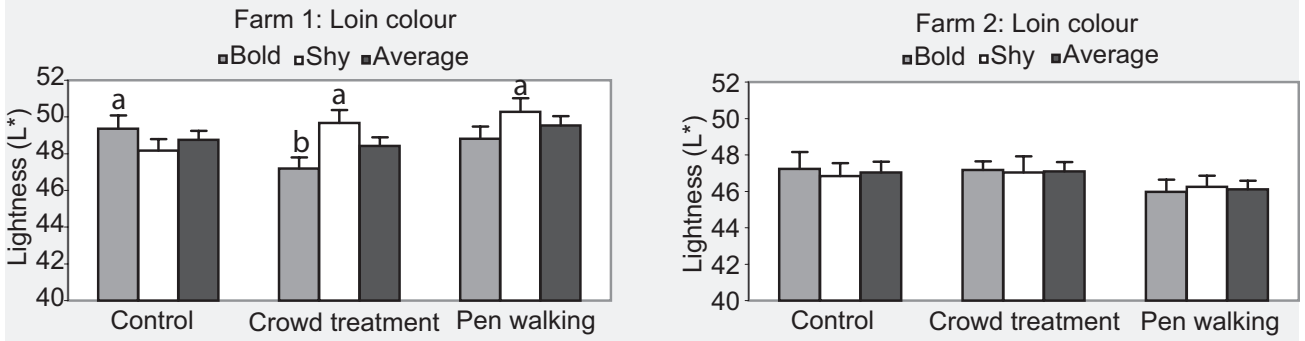


Figure 2: Ham drip loss for Farm 1 and Farm 2 (ls means +/-std err). Different subscripts differ significantly ($P < 0.05$).

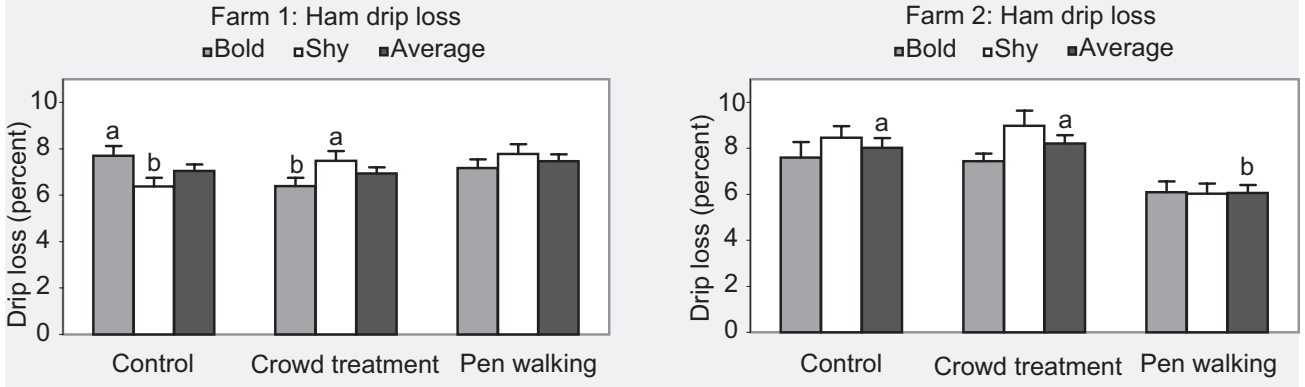
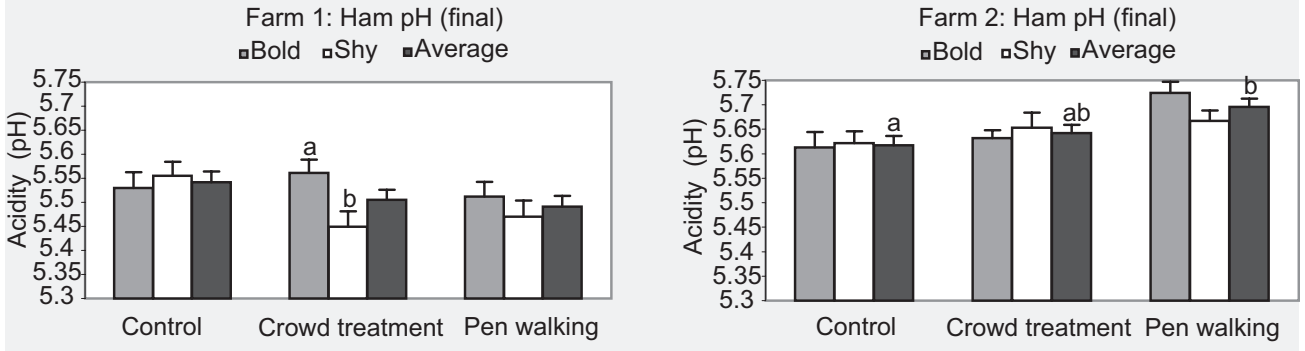


Figure 3: Ham pH (final) for Farm 1 and Farm 2 (ls means +/-std err). Different subscripts differ significantly ($P < 0.05$).



In light of the meat quality benefits found due to on-farm handling, further temperament and handling studies are warranted. A better understanding of the relationship between temperament and handling experience on one hand, and on-farm management factors, nutrition and pre-slaughter handling on the other, is needed to guide the development of optimal handling methods.

Conclusions

Handling treatments performed twice per week over eight weeks on commercial farms resulted in several improvements in key meat quality variables. Benefits included better loin color, reduced drip loss and higher final pH. On one farm (Farm 1), benefits were more pronounced in animals which displayed a 'Bold' temperament in the open door test (i.e. left the home pen readily). On Farm 2, positive effects due to handling were greatest for the Pen Walking treatment where drip loss in ham was significantly reduced. Treatment effects varied significantly on the two farms, and are likely due to farm differences in genetics, on-farm management and/or pre-slaughter handling, which were not controlled.

In conclusion, handling treatments show promise for improving the quality and consistency of pork. It is recommended that producers regularly handle stock, especially in the final weeks of finishing. Further studies on the interaction of temperament and handling experience with nutritional and management factors could help in selection of animals that are less susceptible to stress and refinement of handling techniques, resulting in better pork quality and better welfare at shipping and slaughter.

References

1. Ellis, M., Ritter, M. Management practices and meat quality. Proceedings of the 59th American Meat Science Association Reciprocal Meat Conference, June 18–21 Champaign-Urbana, Illinois, 2006, pp. 29–32.

2. Benjamin, M., Pig trucking and handling- Stress and the fatigued pig. Banff Pork Seminar. Advances in Pork Production, vol. 16, 2005.

3. Koolhaas, J.M., Korte, S.M., De Boer, S.F., Van Der Vegt, B.J., Van Reenen, C.G., Hopster, H., De Jong, I.C., Ruis, M.A.W., Blokhuis, H.J., 1999. Coping styles in animals: current status in behaviour and stress physiology. Neurosci. and Behav. Reviews 23, 925–935.

4. Bolhuis, E.J., Schouten, G.P., Schrama, J.W., Wiegant, V.M., 2005. Individual coping characteristics, aggressiveness and fighting strategies in pigs. Anim. Behav. 69, 1085–1091.

5. Hemsworth, P.H., Price, E.O., Borgwardt, R., 1996. Behavioural responses of domestic pigs and cattle to humans and novel stimuli. Appl. Anim. Behav. Sci. 50, 43–56.

6. Grandin, T. Livestock Handling and Transport. CABI Publishing, 2000.

7. Brown, J.A., E.L. Toth, A.L. Stanton, P. Lawlis, T.M. Widowski, 2006. The effects of different frequencies of weekly human interaction on handling responses in market hogs. Journal of Animal Science 84(Suppl. 1):301.