

Pig Trucking & Handling – Stress and Fatigued Pig

Madonna Benjamin

Elanco Animal Health, B-13 6020 2nd St. S.E. Calgary, AB T2H 2L8 *Email:*
m.benjamin@elanco.com

Introduction

Stress in the period during transport and around slaughter is known to influence the physiological and biochemical processes in pigs (Adeola and Ball, 1992). Pigs that become non-ambulatory without obvious injury, trauma or disease and refuse to walk, during loading, transport, unloading or while in the lairage are considered fatigued. Literature available on pig transport and slaughter suggest recumbent pigs can result from both acute stress/acidosis or physical exhaustion/glycogen depletion or a combination of the two mechanisms. Fatigued pigs, by industry accounts, tend to be of heavy muscled, high lean genotypes and newer genetic lines may be more susceptible to heat stress (Brown-Brandl et al., 2001).

When pigs are stress-challenged during transport, unloading and presentation for slaughter there are a number of visual indicators. Open mouth breathing (dyspnea) is a behavioural sign of acute exercise challenge and reflects increased oxygen demand of exercise in the normally sedentary pig. Early signs of fatigued pigs are muscle tremors and a reluctance to move. Although comprehensive data is lacking, it appears that further excitement or exercise demands to a fatigued or exercise stressed pig result in a more severe compromise of the individual, marked by voluntary recumbency, dyspnea, alternating irregular blanched and reddened areas on the skin, increased body temperature and the development of acute metabolic acidosis. Most fatigued animals may recover from this condition if rested and will return to normal appearance and mobility. Unfortunately some individuals will progress to death.

A model of acute stress resulting in fatigued pigs has been recently developed (Benjamin et al., 2001). This model is a group stress test involving a combination of exercise by running the pigs 100meters, aversive handling by the use of electrical prods and occasionally unpredictable abrupt animal movement restriction by restraining pigs in a narrow alley. Application of this exercise and aversive handling challenge resulted in more than 20% fatigued animals.

This paper examines the current knowledge related to the factors contributing to the incidence of fatigued pigs between the farm of origin and the point of humane killing. Emphasis is placed on recent literature and the practical application of those findings.

Problem Definition

Within North America, normal appearing market ready swine continue to either die in transit (1/1,000 shipped) or die in pen (1/2,000 shipped) despite the identification of the HAL gene and efforts to minimize its expression in the homozygous state in the swine population. In addition to the loss of animals due to death the industry estimates 3-5/1,000 non-compromised hogs leaving the farm become stressed or fatigued prior to humane slaughter at the processing plant. Both mortalities even at a low level and fatigued hogs represent a significant financial loss to the production system and a focal point for concerns related to the welfare of livestock in modern production systems.

Animal Factors

Social Environment:

The social environment of the pig can greatly affect its behavioral and physiological stress state. Mixing of unfamiliar pigs can lead to physical injury (Tan & Shackleton, 1990), elevated stress hormone levels (Moore et al., 1994) and loss of productivity (Stookey & Gonyou, 1994). Upon grouping, pigs will fight for about 20-30 minutes to establish a social hierarchy (Meese & Ewbank, 1973). Once the hierarchy has been established, an individual's relative social status can markedly affect its welfare. Low social status can affect access to resources, such as feed or preferred lying area (O'Connell et al., in press), can compromise immune status (McGlone et al., 1993) and increase physiological stress (Ruis et al., 2002). Low social status pigs also show heightened reactivity when exposed to acute stress (Marchant et al., 1995, Hicks et al., 1998; de Jong et al., 2000), which may include input from both physiological and psychological factors (Zayan, 1991, Marchant et al., 1995). Gonyou (personal communication) subjected market pigs to the electric prod in either in groups of 6 or individually. The rate of fatigue pigs in groups was significantly higher (54%) than when pigs were subjected to the test alone (38%). Although isolation is known to be an independent stressor in swine this trial suggests that social stressors are amplify responses to aversive handling.

Role of Genetics

The clinical presentation of Fatigue pigs is similar to clinical presentation of "Porcine Stress Syndrome" (PSS) pigs as previously described (Topel DG, et al. Mod Vet Pract 1968; 40:30) and continues to occur in pigs that are HAL1843 gene-free pigs (Marr et al., 2004). There is a paucity of public information on the effects of genetics on behavior even though there are widespread anecdotal reports of behavioral differences between different genetic strains. There is some evidence to suggest that there are breed (Ausberger et al., 2002) and perhaps strain (Tor et al., 2001) differences in feeding behavior and that breed may influence the development of harmful social behaviors such as pen-mate-directed biting and nosing (Breuer et al., 2003). Also, and perhaps more importantly in the scope of the fatigued pig, breed differences in the neuroendocrine responses of the HPA axis and behavioral reactivity have been identified following exposure to a novel environment (Désautés et al., 1997). Field data would also appear to support the hypothesis that genetic lines can influence both percent fatigued and percent deaths, with one sire line having higher numbers in both categories than a different sire line (Line G1 - 0.63% and 0.35%, Line G2 - 1.13% and 0.49% respectively (Anderson et al., 2002).

Role of Fear

Understanding both the behavioural and physiological response to fear would likely assist the industry to better understand fatigue pig syndrome. Fear is an emotion that motivates animals to avoid predation (Rogan, 1996). Just as animals can habituate to a procedure or the presence of stimuli, they can be fear-conditioned, triggering both behavioural and physiological responses (Davis, 1992). High pitched vocalization has been associated with a fear response in pigs (von Borell and Ladewig, 1992; Warriss et al., 1994). Benjamin et al, (2001), demonstrated a correlation between the incidence in fatigued animals and vocalization in pigs subjected to goading by use of the electric prod.

Exposure to Handling

In current commercial practice, pigs are becoming less and less exposed to direct human contact and to handling outside the pen. Thus, the processes to which they are exposed at this time can effectively be considered novel. Exposure to novelty often induces stress or fear responses (Stolba & Wood-Gush, 1980) and this can be exacerbated by being reared in a relatively barren environment (Pearce et al., 1989; Beattie et al, 2000), such as the modern finisher barn. Pre-exposure to handling and moving outside the home pen over the weeks prior to hauling to slaughter has been shown to improve the time taken to load at hauling to slaughter (Abbott et al., 1997, Geverink et al., 1998). However, Grandin (1987) and Day et al. (2002) have suggested that pigs exposed to regular positive interactions with humans can in fact be difficult to forcibly move, possibly through reduced fear of humans.

Role of Nutrition

Food is an extremely important resource to the finishing pig. The behavior and physiology of the pig can be influenced both in terms of access to the food and by the composition of the food. For various management reasons, it is common practice to withdraw access to food for a number of hours prior to hauling and, obviously, over the transport and lairage periods. Restricting access to feed (Graves et al., 1978) and fasting (Kelley et al., 1980) have both been shown to increase aggressive behavior among unfamiliar pigs and fasting also results in increased general activity (Fernandez et al., 1995) and enhanced stress-induced glycogen depletion (Fernandez et al., 1995).

Role of Health

Post mortem studies of dead on arrival market pigs have not been particularly useful in understanding the causation of pre-slaughter death loss. Severe and diffuse pulmonary congestion and edema was the only significant lesion found in a Canadian study of 336 dead on arrival market hogs (Clarke, 1979), which is similar to post mortem findings in animals exercised to exhaustion (Steinhardt et al., 1976).

Role of Facilities

Benjamin et al, (2001) demonstrated an increase in fatigued pigs when pigs became wedged with one another. This wedging may occur when animals move from an open pen to a single run or if the aisle is not wide enough for 2 pigs to move side by side.

Role of Goading Methods

Voltage and amperage of the electric prod is not subject to regulation. Earlier work, (Brundige and Zanella et al., 1998), demonstrated that pigs loaded using an electric prod showed significantly higher behavioural and physiological response indicative of stress when compared with pigs loaded using a hurdle. Pigs vocalized, lost their balance, and tried to jump out of the loading area. Similarly, D'Souza et al. (1999) observed that pigs negatively handled on-farm were hesitant and fearful when approached by the stockperson with some pigs jumping out of the lairage pens. Heart rate and body temperature (Brundige et al., 1998) was significantly higher in pigs loaded using electric prod when compared to pigs loaded using a hurdle. Transportation stress, based on cortisol measures, did not override the original cortisol response to loading and maintained high salivary cortisol 2 hours after loading. Lower ultimate pH and lower mean decrease in muscle glycogen concentrations post slaughter in negatively handled pigs on-farm suggest that more muscle glycogen was mobilized post slaughter in negatively handled pigs compared with pigs positively handled on farm (D'Souza et al, 1998)

Human Factors

Role of the Handler

Human Characteristics

To show how the interaction between pigs and humans on-farm can influence the pigs stress response of pre-slaughter handling, and potentially meat quality, studies would suggest that the personality or attitudes of the handler may determine the level of aversive behaviour onto the pig. Gemus-Benjamin et al., 1998 demonstrated that handlers of low self-esteem are more likely to use aversive behaviour than persons of high self-esteem. In deterministic study of attitudes and predicting behaviour of persons working within an Australian abattoir (Coleman et al, 2003), a key finding included that persons with a positive attitude toward pigs were more likely to turn off the electrical source to the prod. Whereas those with negative attitudes were more likely to turn on the electrical source to the prod. Also, using an approach test to determine whether pigs are likely to be easily handled, pigs that have experienced aversive behaviour do not seem to differentiate between handlers (Hemsworth et al., 1994) irrespective of subsequent treatment. This study proposed that in situations where pigs were handled in two markedly different manners, the behavioral response to the negative manner will extend to other humans. These findings may be an important distinction when groups are assigning who is at fault from a handling perspective. While producers may point the blame of fatigue pigs on the trucker, or the trucker on the producer, any event of aversive human-interaction may generate a response of avoidance of a new handler at a different stage of marketing.

Handler Behaviour

Another area of people behaviour is in recognizing when the handler should "back off" on driving of the pigs. Rough handling, pile-ups and excessive use of the electric prods prior to stunning will increase pale soft, exudative pork (Barton-Gade et al., 1984). Based on their cone-shaped phenotype, pigs can become wedged and it is difficult for these pigs to separate from themselves while driving forward. In speculation, if the handler continues to goad the pigs with an electric prod, it further forces the pigs into a trap with reduced opportunity for escape from the aversive handling, and further activating the hypothalamic-pituitary-adrenal axis (HPA).

Role of Training

Pigs that are difficult to handle tended to receive “harsher” treatment during loading and more handler to pig interaction (ie slaps, bumps, pushes) (Weeding et al., 1993). Moving market pigs in small bunches of three to six during loading, unloading and through the stunning process will reduce the amount of bunching or wedging. Also, it is thought that a lone animal is likely to become more panicked. When working in small groups, the pig is less likely to escape. In addition, small groups of calm pigs can be easily moved with alternative driving aids such as plastic paddles, flags and panels and hurdles (peer communication). Continued training of handlers is likely to decrease the incidence of fatigued pigs. One US plant, which has adopted a policy of low stress handling and transport, and eliminated the use of the prod, has lowered the incidence of fatigued pigs to 0.4/1000 head shipped, this number is compared to the predicted US national average of 1.2/1000 pigs shipped (peer communication).

Conclusions

The Role of the Industry

What Has Been Done

Unifying the swine industry to act on the economic and welfare issues surrounding fatigue pigs has strong repercussions on the next steps. At present, the US National Pork Board has assembled a group consisting of industry representatives and academia to assemble known information on transport and fatigue pigs. Committees such as Alberta, Ontario and Saskatchewan Farm Animal Care have researched and provided information to producers to increase success in pig loading management.

What Needs to be Done

The food chain culture, albeit farm, transport or packing plant, will be the major determinant of the future incidence of fatigued or stress swine. Because most motivations are derived from economics, additional research conducted using US and Canada production facilities, transport, packing facilities and genetics are needed to determine the marginal profit benefits to improved animal handling.

References

- Abbott, TA., EJ. Hunter, HJ. Guise, and RHC. Penny. 1997. The effect of experience of handling on pigs' willingness to move. *Appl. Anim. Behav. Sci.* 54:371-375.
- Adeola O. and RO. Ball. 1992. Hypothalamic neurotransmitter concentrations and meat quality in stressed pigs offered excess dietary tryptophan and tyrosine. *J. Anim. Sci.* 70:1888-1894.
- Anderson, DB., DJ. Ivers, ME Benjamin, HW Gonyou, DJ Jones, KD Miller, RK McGuffey, TA Armstrong, DH Mowray, LF Richardson, R Seneriz, JR Wagner, LE Watkins, and AG Zimmerman. 2002. Physiological responses of market hogs to different handling practices. Presented at: American Association of Swine Veterinarians. Kansas City, Mo.
- Ausberger, NR, M Ellis, DN Hamilton, BF Wolter, JL Beverly, and ER Wilson. 2002. The effect of sire line on the feeding patterns of grow-finish pigs. *Appl. Anim. Behav. Sci.* 75:103-114.
- Barton-Gade, P, and L. Christenson. 1998. Effect of different stocking densities during transport on welfare and meat quality in Danish slaughter pigs. *Meat Sci.* 48:237-247.
- Beattie, VE, NE O'Connell, DJ Kilpatrick, and BW Moss. 2000. Influence of environmental enrichment on welfare-related behavioural and physiological parameters in growing pigs. *Anim. Sci.* 70:443-450.
- Benjamin ME, HW Gonyou, DJ Ivers, LF Richardson, DJ Jones, JR Wagner, R Seneriz and DB Anderson. 2001. The effect animal handling model on the incidence of stress responses in market swine in a model system. *J. Anim. Sci.* 79:279 (Abst).
- Breuer, K, MEM. Sutcliffe, JT Mercer, KA Rance, VE Beattie, IA Sneddon, and SA Edwards. 2003. The effect of breed on the development of adverse social behaviours in pigs. *Appl. Anim. Behav. Sci.* 84:59-74.
- Brown-Brandl TM, RA Eigenberg, JA Nienaber, and SD Kachman. 2001. *Livestock Prod Sci* 71:253-260.
- Brundige L, T Oleas, M Doumit and AJ Zanella, 1998. Loading techniques and their effect on behavioural and physiological responses of market weight pigs.
- Clark, E G. (1979). "Necropsy survey of transport stress deaths in Saskatchewan market weight hogs." *Proceedings of the American Association of Veterinary Laboratory Diagnosticians* 22: 53-60.
- G.J. Coleman, M. McGregor, P.H. Hemsworth, J. Boyce, S. Dowling. 2003. The relationship between beliefs, attitudes and observed behaviours of abattoir personnel in the pig industry. *Appl. Anim. Behav. Sci.* 82:189-200.
- Davis, M. 1992. The role of the amygdala in fear and anxiety. *Ann. Rev. Neurosci.* 15:353. Day, JEL, HAM. Spooler, A Burfoot, HL Chamberlain, and SA Edwards. 2002. The separate and interactive effects of handling and environmental enrichment on the behaviour and welfare of growing pigs. *Appl. Anim. Behav. Sci.* 75:177-192.
- De Jong, IC, IT Prelle, JA van de Burgwal, E Lambooi, SM Korte, HJ Blokhuis, and JM Koolhaas. 2000. Effects of rearing conditions on behavioural and physiological responses of pigs to pre-slaughter handling and mixing at transport. *Can. J. Anim. Sci.* 80:451-458.
- Désautés, C, JP Bidanel, and P Mormède. 1997. Genetic study of behavioral and pituitary-adrenocortical reactivity in response to an environmental challenge in pigs. *Physiol. Behav.* 62:337-345.
- D'Souza DN, FR Dunshea, BJ Leury, and RD Warner. 1999. Effect of mixing boars during lirage and pre-slaughter handling on pork quality. *Aust. J Agric. Res.* 50:109-113
- D'Souza DN, FR Dunshea, RD Warner, B. J. Leury. 1998. The effect of handling pre-slaughter and carcass processing rate post-slaughter on pork quality. *Meat Sci.* 50:429-437.
- Fernandez, X, MC Meunier-Salaun, P Ecolan, and P Mormède. 1995. Interactive effect of food deprivation and agonistic behavior on blood parameters and muscle glycogen in pigs. *Physiol. Behav.* 58:337-345.
- Gemus-Benjamin, ME, P Bartlet, R Nachreiner, AJ Zanella. 1998. Human characteristics and handling strategies: effect on the physiological and behavioural responses of juvenile pigs. In: *Proc International Pig Veterinary Society, Birmingham UK.*
- Geverink, NA, A Kappers, JA van de Burgwal, E Lambooi, HJ Blokhuis, and VM Wiegant. 1998. Effects of regular moving and handling on the behavioral and physiological responses of pigs to pre-slaughter

- treatment and consequences for subsequent meat quality. *J. Anim. Sci.* 76:2080-2085.
- Grandin, T 1987. Animal handling. *Vet. Clin. North Am. Food Anim. Pract.* 3:323-338.
- Graves, H.B., K.L. Graves, and G.W. Sherritt. 1978. Social behavior and growth of pigs following mixing during the growing-finishing period. *Appl. Anim. Ethol.* 4:169-180.
- Hemsworth, PH, GJ Coleman, and JL Barnett. 1994. Improving the attitudes and behaviour of stockpeople towards pigs and the consequences and the behaviour and reproductive performance of commercial pigs. *Appl. Anim. Behav. Sci.* 40: 129-142.
- Hemsworth, PH. 2003. Human animal interactions in livestock production. *Appl. Anim. Behav. Sci.* 81:85-98
- Hicks, TA, JJ. McGlone, CS. Whisnant, HG. Kattesh, and RL. Norman. 1998. Behavioural, endocrine, immune, and performance measures for pigs exposed to acute stress. *J. Anim. Sci.* 76:474-483.
- Kelley, KW, JJ. McGlone, and CT. Gaskins. 1980. Porcine aggression measurements and effects of crowding and fasting. *J. Anim. Sci.* 50:336-341.
- Marchant, JN., MT. Mendl, AR. Rudd, and DM. Broom. 1995. The effect of agonistic interactions on heart rate of group-housed sows. *Appl. Anim. Behav. Sci.* 46:49-56.
- Marr, AL, CP Allison, NL Berry, DB Anderson, DJ Ivers, LF Richardson, K. Keffaber, RC Johnson and ME Doumit. 2004. Impact of halothane sensitivity on mobility status and blood metabolites of HAL-1843-free pigs following an aggressive handling model. *J. Anim. Sci.* 82:33 (Abst)
- McGlone, JJ, JL Salak, EA Lumpkin, RI Nicholson, M Gibson, and RL Norman. 1993. Shipping stress and social status effects on pig performance, plasma cortisol, natural killer cell activity, and leucocyte numbers. *J. Anim. Sci.* 71:888-896.
- Meese, GB and R Ewbank. 1973. The establishment and nature of the dominance hierarchy in the domesticated pig. *Anim. Behav.* 21:326-334.
- Moore, AS, HW Gonyou, JM Stookey, and DG McLaren. 1994. Effect of group composition and pen size on behaviour, productivity and immune responses of growing pigs. *Appl. Anim. Behav. Sci.* 40:13-30.
- O'Connell, NE, VE Beattie, and BW Moss. Influence of social status on the welfare of pigs reared in barren and enriched environments. *Anim. Welfare*, (in press).
- Pearce, GP, AM Paterson, and AN Pearce. 1989. The influence of pleasant and unpleasant handling and the provision of toys on the growth and behaviour of male pigs. *Appl. Anim. Behav. Sci.* 23:27-37.
- Rogan, MT. and J. E. LeDoux. 1996. Emotion: Systems, cells, and synaptic plasticity. *Cell* 85:369.
- Ruis, MAW, JHA. Brake, B Engel, WG Buist, HJ Blokhuis, and JM Koolhaas. 2002. Implications of coping characteristics and social status for welfare and production of paired growing gilts. *Appl. Anim. Behav. Sci.* 75:207-231.
- Steinhardt, M, U Bunger, L Lyhs, and G Lowe 1976. Pathophysiological aspects of transport stress on swine. V. Pathophysiological mechanism of exhaustion. *Monatshefte fur Veterinarmedizin* 31(16): 606-610.
- Stolba, A, and DGM. Wood-Gush, 1980. Arousal and exploration in growing pigs. *Appl. Anim. Ethol.* 6:381-382.
- Stookey, JM and HW Gonyou. 1994. The effects of regrouping on behavioural and production parameters in finishing swine. *J. Anim. Sci.* 72:2804-2811.
- Tan, SSL. and DM Shackleton. 1990. Effects of mixing unfamiliar individuals and of azaperone on the social behaviour of finishing pigs. *Appl. Anim. Behav. Sci.* 26:157-168.
- Tor, M, J Estany, D Villalba, D Cubilo, J Tibau, J Soler, A Sanchez, and JL Noguera. 2001. A within-breed comparison of RYR1 pig genotypes for performance, feeding behaviour and carcass, meat and fat quality traits. *J. Anim. Breed. Genet.* 118:417-427.
- Topel, D. G., E. J. Bicknell, K. S. Preston, L. L. Christian, and C. Y. Matsushima. 1968. Porcine stress syndrome. *Mod. Vet. Practices.* 49:40.
- Von Borell, E, and J Ladewig. 1992. Relationship between behaviour and adrenocortical response pattern in domestic pigs. *Appl. Anim. Behav. Sci.* 34:195-206.
- Warriss, PD and SN Brown. 1994. A survey of mortality in slaughter pigs during transport and lairage. *Vet. Rec.* 143:513-515. Weeding, CM, EJ Hunter et al. 1993. Effects of abattoir and slaughter handling systems on stress indicators in pig blood. *Vet. Rec.* 133:10-13. Zayan, R. 1991. The specificity of social stress. *Behav. Proc.* 25:81-93