

# **The Welfare of Pigs: Review of Recent Literature**

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## **Introduction**

Animal welfare issues pertaining to pig farming are diverse, and scientific efforts to address these issues have resulted in a plethora of new literature. This review consolidates and summarizes this literature in an effort to provide a better understanding of pig welfare. Considerable attention has been given to housing design, husbandry and transportation of pigs.

## **Housing**

A considerable amount of research has been directed at examining housing systems for pigs, however, there is no consensus as to which is the best system. It is recommended that readers refer to the original papers for further details on each system.

Confining sows and gilts for extended periods of time, such as when kept in gestation stalls or farrowing crates, has received much criticism. While these practices have been known to lead to problems such as increased stereotypic behaviour, lameness and chronic stress, they also help to reduce aggression and provide greater control over feed intake. Sows are highly motivated to perform nesting behaviour in the prepartum period. Despite the physical restriction and absence of nesting material, sows in farrowing crates have been found to display an intense effort to build a nest (Harstock and Barczewski, 1997). Providing stalled gilts with the opportunity to turn around has been suggested as a means to improve well-being. Bergeron et al. (1996) found that keeping gilts in turn-around stalls, which allowed greater movement and interaction with neighbors, led to reduced plasma levels of the stress hormone, cortisol.

There is currently a trend toward housing of sows and gilts in groups. While group-housing was established to improve well-being, it may lead to problems with aggression and an increase in social stress. Stress and injury caused by mixing sows is a major welfare concern. To reduce the effects of aggression, it is recommended that sows be supervised following mixing (Arey and Edwards, 1998). Aggression is influenced by housing system, stocking density, feeding method and method of mixing sows (Marchant et al., 1995). Gjein and Larssen (1995) found lesions on the vulva of group-housed sows but not tethered or stalled sows. Providing sows with roughage, such as straw or hay, has been shown to reduce this problem (Gjein and Larssen, 1995). Most aggression between sows occurs during feeding. The use of electronic sow feeders in group-housing systems may help to reduce frustration since they allow sows to adopt individual feeding patterns (Eddison and Roberts, 1995). This is particularly important for sows that are newly introduced to a group. Similarly, the use of body partitions can help to reduce aggression at feeding (Anderson et al., 1999). The stress response incurred during fighting can have detrimental effects on reproduction. However, with good management practice problems with poor reproductive performance can be avoided (Arey and Edwards, 1998).

Currently, the appropriate space allowance or optimum group size for pigs in group-housing systems is unknown. Weng et al. (1998) investigated the space requirements of six pregnant sows and concluded that, under the conditions of their study, the minimum space allowance to promote good welfare was between 2.4 and 3.6 m<sup>2</sup>/sow. Beattie et al. (1996a) found that weight gain and feed efficiency improved when growing pigs were housed in environments with a floor space of no greater than 1.7 m<sup>2</sup>/pig. They also found that pigs provided with straw and peat were less likely to engage in harmful social behaviour regardless of space allowance, suggesting that environmental complexity may be more important than the amount of space provided. Further research is necessary to determine the appropriate space allowance for group-housed pigs.

Alternative housing systems for the sows and their litters have also been investigated. The first few weeks during lactation is critical for piglets as this is when they are the most sensitive to socialization. It is suggested that confinement of the sow and her litter may inhibit socialization. Beattie et al. (1996b) found the previous experience of the dam had an impact on the development of social behaviour in piglets. Offspring from sows that were raised in barren environments tended to fight more than offspring from sows raised in enriched environments. Furthermore, fighting was also higher in piglets raised in barren environments.

Pajor et al. (1999) examined a sow-controlled housing system which enables the sow to leave her piglets at will, thereby, encouraging a more natural weaning process. The performance of the piglets raised in this system was found to be improved when compared to piglets confined in a pen with their dam. Although, there was only slight evidence of an effect on behavioural indicators of stress for either the piglets or sows raised in this system. Similarly, Hultén et al. (1995) tested a group-housing system for lactating sows and their litters. In this system, sows were individually housed from a few days before farrowing until the second week of lactation after which they were group housed until weaning. The investigators found less wounding to the teats and udders of sows kept in the group-housing system. They also found that interactions between the sow and piglets decreased and that some sows actually weaned their piglets during the lactation period. Piglets in the group-housing system were found to be more active and spend less time with the sow than conventionally-reared piglets.

## **Enrichment**

Providing enrichment has a number of benefits. Enriching the environment with toys or substrates, such as bark or wood shavings, has been found to reduce aggression in pigs (Blackshaw et al., 1997; Morita et al., 1998). Pigs kept on solid floors and provided with bedding, such as straw, have been found to eat more and gain more weight and they tend to have fewer leg injuries, such as adventitious bursitis (Lyons et al., 1995; Mouttotou et al., 1998). Slatted floors and a lack of bedding, on the other hand, have been found to contribute the most to leg injuries (Lyons et al., 1995).

Providing straw bedding has been found to enhance the welfare of early-weaned piglets. Piglets housed on deep straw seem to recover faster from injury and have reduced stress than piglets housed in flatdecks (Kelly et al., 2000). Beattie et al. (1998) found the substrates peat, mushroom compost and sawdust to be preferred over sand and woodbark in a study conducted on growing pigs. Interestingly, straw was preferred only to concrete. Providing a substrate can help to increase the time that pigs spend exploring and decrease behaviour such as chewing on ears and tails of pen-mates. Rearing pigs in a barren environment is thought to hinder the

development of social skills and may facilitate the development of chronic stress during adulthood (De Jonge et al., 1996).

## **Stereotypic Behaviour**

Stereotypic behaviour is common in gestating sows housed in barren or physically restrictive environments. Food restriction of gestating sows is commonly practiced to reduce excessive weight gain and to stimulate feed intake during lactation, however, it is one of the major factors contributing to the development of stereotypic behaviour in sows. High fibre diets (Robert et al., 1997; Whittaker et al., 1998) and high-energy diets (Bergeron and Gonyou, 1997) have both been found to be effective in increasing satiety and reducing stereotypic behaviour in sows providing that the nutrient requirements of the sows are met (Brouns et al., 1997; Robert et al., 1997).

## **Weaning**

Weaning under natural or semi-natural conditions is a gradual process and generally occurs when the piglets are between 11 and 16 weeks old (Worobec and Duncan, 1997). In conventional systems, weaning generally occurs when the piglets are between 21 and 28 days of age and in segregated early weaning systems (SEW) weaning may occur when they are less than 10 days of age up until the piglets are 21 days of age (Robert et al., 1999). Weaning in these systems is abrupt and there is evidence to suggest that it causes distress especially for the younger piglets.

Piglets weaned at younger ages tend to have reduced performance after weaning, higher levels of aggression and they direct more oral behaviour, such as belly-nosing at their pen-mates, than piglets weaned later (Robert et al., 1999; Weary et al., 1999; Worobec et al., 1999). In addition, younger piglets tend to vocalize more after weaning, and may have a weakened immune response suggesting that piglets adapt better to weaning at older ages (Weary and Fraser, 1997; Weary et al., 1999).

## **Castration**

Research investigating the optimum conditions under which to castrate piglets has revealed that castration may be more stressful when piglets are less than 8 days of age and when they are castrated without the use of an anesthetic. Kielly et al. (1999) showed that castrating piglets at 3 days of age may temporarily reduce weight gain, while castrating piglets at 10 days of age does not. In another study it was shown that piglets castrated with the aid of a local anesthetic had lower heart rates and vocalized less than piglets that were castrated without the use of an anesthetic, suggesting that the use of an anesthetic reduces the stressfulness of castration (White et al., 1995).

## **Teeth Clipping**

Piglets are born with sharp needle teeth. Needle teeth are generally used to establish dominance and can cause considerable damage to the faces of littermates. In addition, they may also damage the udder of the sow during suckling. To prevent damage, the sharp tips of the needle teeth are routinely clipped off. This procedure is generally performed shortly after

birth on piglets housed in indoor systems. There is debate about the necessity of teeth clipping in outdoor systems. As pigs housed outdoors are not as used to the presence of humans, performing this procedure could lead to a disruption in maternal behaviour which could have more serious consequences than leaving teeth unclipped (Brown et al., 1996). Brown et al. (1996) found that while leaving teeth unclipped resulted in more facial lesions, piglet weight gain and survival were not affected. In addition, there was no evidence to suggest that the sows with unclipped litters were trying to avoid suckling attempts from their piglets.

## **Transport**

Transport to the slaughterhouse is a stressful procedure for pigs. Preparation for this procedure can begin during the finishing period. Regular moving and handling during the finishing period tends to result in pigs that are easier to handle and may improve their ability to cope with preslaughter stressors (Abbott et al., 1997; Geverink et al., 1998). Furthermore, the attitude of the handler can have a major effect on the behaviour of pigs. Positive handling by the stockperson can result in pigs that show less fear to novel objects (Hemsworth et al., 1996) which could further reduce the stressfulness of transport.

Loading is known to be the most stressful phase of transport (Bradshaw et al., 1996b). Bradshaw et al. (1996b) observed an initial peak in plasma cortisol levels following loading but cortisol levels in transported pigs still remained higher compared to non-transported pigs up to 5 hours into the journey which suggests that transport itself is stressful. Mixing pigs at loading can further elevate the stressfulness of this procedure. Pigs that are mixed during transport have been shown to have increased activity, increased fighting and have higher cortisol levels than pigs that are not mixed (Bradshaw et al., 1996b).

Other factors influencing the stressfulness of transport include the levels of vibration and acceleration during transport. Perremans et al. (1998) recommend avoiding low vibration frequencies and high accelerations as these factors were found to influence maximum heart rate during transport.

Travel sickness can occur when transporting pigs. Travel sickness has been defined as retching, chewing, foaming at the mouth, and sniffing at the air. Pigs are sensitive to different types of journeys. Pigs exposed to rough journeys tend to have higher cortisol levels and are more likely to become travel sick if presented with food before traveling (Bradshaw et al., 1996a). Plasma lysine vasopressin levels have been shown to correspond to behavioural signs of travel sickness suggesting this may be a useful indicator of welfare in pigs being transported (Bradshaw et al., 1996a).

Following transport to the slaughter plant a period of rest in lairage is generally recommended. However, Geverink et al. (1996) suggest that from the point of view of welfare, it may be better to slaughter the animals immediately upon arrival at the slaughter plant. Fraqueza et al. (1998) found the proportion of carcasses with skin damage increased with lairage time and it was suggested that this was due to longer durations of aggressive encounters. However, Fraqueza et al. (1998) also observed a reduced incidence of PSE meat during increased lairage time (3 hours vs 0.5 hours) at an environmental temperature of 20 ° C but this relationship did not hold true at an environmental temperature of 30 ° C. Therefore, to evaluate the benefits of rest in lairage, the length of time and environmental temperature should be considered.

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## Abstract or Summary of Interesting Publications

Beattie, V.E., N.Walker, and I.A.Sneddon. 1996. An investigation of the effect of environmental enrichment and space allowance on the behaviour and production of growing pigs. *Appl.Anim.Behav.Sci.* 48:151-158.

Enriching the environment, by the addition of straw and peat has been found to reduce the incidence of persistent nosing of pen-mates and tail biting. Similarly, it has been found that this behaviour may be reduced by increasing the space allowance. In contrast, decreasing the space allowance has been found to lead to increased agonistic behaviour as well as tail biting and cannibalism. It is unknown whether enrichment or space allowance plays a greater role in influencing pig behaviour. In this paper, pigs that were placed in environments with an allocated floor space of 0.5 m<sup>2</sup> per pig and enriched with straw and peat were found to behave similarly to pigs that were placed in environments with an allocated floor space of 2.3 m<sup>2</sup> per pig and deprived of these enrichment substrates. These pigs were found to spend more time inactive than pigs that were provided with either 1.1 or 1.7 m<sup>2</sup> per pig and provided with straw and peat. Pigs housed in a barren environment were found to spend more time engaging in harmful social behaviour than pigs housed in an enriched environment regardless of the space allowance. The weight gain and feed efficiency of pigs tended to be better when the pigs were housed in environments with a floor space of no greater than 1.7 m<sup>2</sup> per pig. Pigs that were provided with 2.3 m<sup>2</sup> per pig, and housed in either an enriched pen or a barren pen, performed more poorly than pigs housed at either 0.5, 1.1 or 1.7 m<sup>2</sup> per pig and housed in an enriched environment. Increasing space allowance per pig above the recommended requirements for production was not beneficial in terms of behaviour and did not improve production performance. However, environmental enrichment did appear to be important. The results of this study suggest that it is not the amount of space that is important in determining pig behaviour but the overall complexity of that space.

Hartsock, T.G. and R.A.Barczewski. 1997. Parturition behavior in swine: effects of pen size. *Journal of Animal Science* 75:2899-2904.

Confinement of sows to crates for farrowing was an effort to reduce piglet death due to crushing by the sow. While, wild or feral pigs build nests in the prepartum phase, farrowing crates restrict the movement of the sow and offer few of the requisites necessary for this activity. Researchers have found that sows kept in farrowing crates will increase their activity a few hours before farrowing as a substitute for nest-building. The aim of this study was to document the prepartum behaviour of confined sows and to determine whether pen size affects prepartum behaviour. Sows were assigned to either a farrowing crate, which prevented both walking and turning, a small pen (2.1 x 2.1 m), which prevented walking but allowed turning, or a large pen (4.2 x 4.2 m), which allowed both walking and turning. Sows in this study were found to become more active as they approached farrowing. They were found to stand, sit, lie with their legs under, change positions, drink, urinate, defecate, root on the floor and pipes, mouth the waterer and pipes and paw the floor more during the 24 hours before the birth of the first pig than during the previous two days. The frequency of position changes, rooting the floor and pawing were found peak during the 6 hours prior to parturition and were suggested to be possible predictors of parturition. Sows kept in farrowing crates were found to be less active than sows in either pen size, with the exception of position changes which were found to be performed more by sows in farrowing crates. Sows kept in farrowing crates were found to stand, root the floor and paw less than sows in either of the pen sizes. All sows were found to display an intense effort to build a nest even in the absence of nesting material and

when turning and walking were not possible. Pipe biting and other behaviours commonly thought to be caused by confinement stress were found to occur in all three types of pens and were suggested to be components of nest-building, expressed inappropriately, in a barren environment. The authors conclude that sows confined to relatively barren pens that restrict movement are still motivated to exhibit natural behaviours within the limits of their environment and direct these behaviours toward available substrates that might allow for at least a partial expression of these behaviours.

Kelly, H.R.C., J.M. Bruce, S.A. Edwards, P.R. English, and V.R. Fowler. 2000. Limb injuries, immune response and growth performance of early-weaned pigs in different housing systems. *Animal Science* 70:73-83.

Alternative housing systems have been developed in response to concern for the ability of modern intensive housing to provide for the behavioural and physiological needs of farmed livestock. A number of factors need to be considered when choosing housing for early-weaned pigs. For example, perforated floors are used in an attempt to improve hygiene and the cleanliness of the animals. However, the use of perforated floors may result in injury. While the use of straw bedding may prevent injury, it may also encourage the spread of enteric diseases. In this study, the suitability of different housing systems for early-weaned pigs was investigated. The housing systems were: a) deep-straw; b) Straw-Flow®; c) large flatdeck (0.23 m<sup>2</sup>/pig); d) small flatdeck (0.17 m<sup>2</sup>/pig). Immediately after weaning, pigs fight to establish a hierarchy and this can be the most dangerous time with regard to foot injury. In this study, 24.1% of the pigs had foot injuries at weaning. While pigs with foot injuries recovered quickly on deep-straw, injuries on pigs housed in flatdecks increased immediately after weaning, with Straw-Flow® being intermediate. In addition, injuries were found to be more persistent in the pigs housed in the small flatdecks. Adventitious bursitis of the hock reflects the hardness of the floor. In this study, only the deep-straw improved the bursitis scores over the weaning period. An immune challenge was used as a measure of chronic stress in this study. Pigs that had experienced a stressful environment were expected to show decreased Ig M levels and increased Ig G and Ig A. In this study, pigs weaned in the flatdecks had decreased Ig M and increased Ig G and Ig A suggesting an increase in stress in flatdeck-reared pigs. A solid, bedded floor was found to be beneficial in terms of welfare. Straw bedding was found to enhance measures of health and therefore provided welfare benefits for early-weaned pigs.

Weary, D.M., M.C. Appleby, and D. Fraser. 1999. Responses of piglets to early separation from the sow. *Appl. Anim. Behav. Sci.* 63:289-300.

In recent years, piglets weaned earlier than 4 weeks of age often showed significant growth check, digestive problems, and abnormal behaviour. With the development of diets that are much better suited to the immature digestive system of young piglets, some of these problems have been reduced. As a result, it is now common in North America for piglets to be weaned at 10-21 days. In commercial pig production, weaning generally involves a sudden separation of the piglets from the sow at an age when the young are primarily nourished by the sow's milk. Premature separation from the mother often results in prolonged vocalizations and restless activity and is a cause of distress in many animal species. While specialized diets may allow early-weaned piglets to achieve satisfactory growth rates, it does not address the welfare concern of distress caused by early separation. In this study, the effect of age and diet on the behavioural responses of piglets to separation from the sow, were examined. In one experiment, vocalizations of 1, 2, 3, and 4-week old piglets were recorded during a 10-minute isolation period. While the piglets of all ages vocalized when isolated from the sow, older piglets had a lower call rate, especially when the calls were

high frequency ( $> 500$  Hz). Piglets make distinctive 'quacking' vocalizations when returned to the sow, and older piglets were found to produce fewer of these calls than younger piglets. This likely reflects a decline in the animals' distress at separation as the age of the animal increases. In a second experiment, piglets were weaned at either 2 weeks of age and fed a diet formulated for piglets of this age, or at 4 weeks of age and fed either a diet typically provided for piglets of this age or a more palatable and nutritionally complex diet. Piglets that were weaned at 4 weeks of age and fed a standard diet were found to produce high-frequency calls at a higher rate than those weaned onto a more complex diet. However, there was no effect of diet on the incidence of belly-nosing. In addition, there was no difference in the body weight of the piglets fed the different diets at 28 days. Piglets weaned at 2 weeks produced almost twice as many high-frequency calls and performed more than twice as much belly-nosing than piglets weaned at 4 weeks and fed either diet. Piglets weaned at 2 weeks were found to achieve post-weaning weight gains equivalent to that of piglets weaned at 4 weeks. The authors conclude that separation distress and frustration of suckling motivation are significant problems when piglets are weaned at less than 4 weeks of age.