# Research on Group-Housing for Sows

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## ABSTRACT

Sow housing is a controversy issue in the swine industry. The conventional confinement housing system for sows, such as gestation stalls and farrowing crates have been used in the western countries for more than 30 years. Despite the advantages of confinement sow housing systems, concern over sow welfare due to restriction of movement has resulted in gestation stalls being banned in the European Union and several states in the U.S. In addition, the largest pork producers in the U.S. and Canada, some chain restaurants and grocery stores have announced to phase out gestation stalls in favor of group housing systems. However, group-housing systems for gestating sows present challenges of controlling individual feed intake and fighting at mixing. To control individual feed intake, several feeding systems, such as electronic sow feeders, free access stalls, and trickle feeding systems have been developed for group-housed gestating sows. Each feeding system has advantages and disadvantages in terms of controlling individual feed intake, efficient use of floor space, and facility investment. Regardless of the type of feeding facility chosen, all group-housing systems subject sows to aggression at mixing, which compromises the welfare and performance of sows. Management strategies to minimize aggression among sows include nutritional, social, and physical interventions. Scientists at the University of Minnesota investigated whether these management strategies, such as supplementation of dietary tryptophan, mixing after pregnancy confirmation, sorting by parity, and providing hiding spaces could reduce aggression among sows. The data showed that some management strategies reduced aggression-associated injuries and improved farrowing rates, suggesting that the welfare and performance of group-housed gestating sows can be safeguarded by proper management strategies and housing facilities.

Key Words: Sow housing, gestation, feeding systems, aggression, well-being, U.S.A.

## 1. INTRODUCTION

Group housing of gestating sows is a welfare-friendly system based on the criteria of freedom of movement (Brambell Report 1965), choice of micro-environment, and performance of natural behavior (Fraser 2008). Indeed, sows from group housing have less stereotypies and are easier to handle compared to sows in gestation stalls (Broom et al. 1995; Jensen et al. 1995). Long-term functional benefits have also been reported. After spending several parities in group housing, mature sows had stronger bones and less atrophy of muscles than sows housed in gestation stalls (Marchant and Broom 1996). In addition, Hemsworth et al. (2006) reported that during the late stage of gestation, group-housed sows had lower cortisol levels than stalled sows. Group housing is already required in most EU countries, Australia, and New Zealand due to concerns from consumers about sow welfare in gestation stalls. By the end of 2012, nine states in the United States have approved bans on individual stalls for pregnant sows. However, group housing subjects sows to aggression at mixing, which can cause injuries (Hodgkiss et al. 1998; Turner et al. 2006) and increase cortisol concentrations (Hemsworth et al. 2006; Li et al. 2011).

Aggression experienced during the early stage of gestation can result in loss of embryos and reduction of conception rate (Olsson and Svendsen 1997; Spoolder et al. 2009). In addition, group-housing presents challenges of controlling individual feed intake of sows. Sows that are over or under fed will suffer from poor body condition. Failure to conceive and poor body condition can result in sows being culled at an early age which affects sow longevity and reproductive efficiency of a sow herd (Spoolder et al. 1997). So, the success of group-housing gestating sows depends on controlling individual feed intake and aggression among sows.

## 2. FEEDING SYSTEMS FOR GROUP-HOUSED SOWS

Individual feed intake of group-housed sows can be controlled by selecting the feeding system. We usually classify housing systems based on what kind of feeding facility is used. Currently, six feeding systems are used by swine producers: floor feeding, feeding stalls, electronic sow feeders (ESF), free-access stalls, trickle feeding, and stall feeding station. Each system has advantages and disadvantages in terms of controlling individual feed intake, efficient use of floor space, and facility investment. In addition, each system needs different management skills of stockmen.

Floor feeding is the simplest and cheapest way to house gestating sows in groups. Feed is dropped on the solid floors through feed lines, and each sow has a feed pile on the floor. Floor feeding can efficiently use the floor space because the area for feeding is also used as rest areas. The problem with floor feeding is that it cannot control individual feed intake and aggression during feeding, which results in poor body condition and injuries in sows.

The feeding stall system provides one stall to each sow in a pen. The stalls can be shoulder-length, half body-length, or full body-length. The full body-length stalls can be either gated or non-gated. With gated feeding stalls, sows are locked in stalls when they are eating so that each sow can consume the ration without disturbance from their pen mates. The gated feeding stall system can control individual feed intake well as in gestation stalls and eliminate aggression during feeding. If sows are mixed in pens at weaning, feeding stalls can also be used for breeding. Using feeding stalls needs more space compared to the floor feeding system, because the stalls are mainly used for feeding and we still need to provide floor space for resting and other activities.

The electronic sow feeder (ESF) system can control individual feed intake well and eliminate aggression during eating. Each ESF can feed up to 60 sows, and does not take much floor space. The computerized feeding system can record eating activity for individual sow and mark sows that are due to farrow or needs special care. Sows and gilts need to be trained when they are newly introduced into the ESF system. It usually takes a week to train these animals. There is evidence that about 5% to 10% of gilts and sows cannot be trained to use the ESF system, which may vary with the genetics of sows and the design of the ESF station. Maintenance and operation of the computerized ESF system requires skills and experience of stockmen. In addition, the ESF system is expensive, so facility investment and maintenance cost is relatively high.

The free-access stall system is a walk-in, lock-in system. Because sows are locked in stalls while feeding, free-access stalls can control individual feed intake and eliminate aggression during feeding well as in gestation stalls. In addition, free-access stalls allow sows to eat simultaneously, which is different from the ESF system that requires sequential feeding (feeding one sow at a time). Similar to the feeding stall system, the free-access stall system requires more floor space than other feeding systems. In addition, the facility costs more than regular feeding stalls.

The trickle feeding system drops feed at a speed that matches the eating speed of sows so that each sow can be attracted (or fixed) at their feeding points. The feeding points are usually divided with partial (shoulder length) partitions, which prevent sows stealing feed from each other. The feeding system does not occupy much space as the full body-length feeding stalls or free access stalls, so it is efficient for floor space usage. The trickle feeding system works better in small groups where sows can be sorted by parity or size, because sows that are similar in age and size usually are similar in competitive ability for feed and eat at similar speed. These sows will consume their ration within a similar time period, and no feed will be stolen by their pen mates. However, in large groups where old and young sows are housed together, old sows usually eat faster than young sows, and they could steal feed from young sows when they are done eating their ration.

The stall feeding station is used as a cafeteria (or a restaurant) to feed several groups of sows in a day. Sows in each group are given about 30 min to eat in individual stalls. This system can control individual feed intake and use floor space efficiently. However, it needs more labor to move sows between the pen and the feeding station, and there are concerns about worker safety when moving large groups of sows daily.

The group housing system itself does not enhance sow welfare if the appropriate management protocols and stockman skills are not implemented. To safeguard sow well-being and performance in group-housing, we need to understand the housing system, develop appropriate management protocols, and train our employees to implement the protocols on a daily basis.

## 3. RESEARCH ON MANAGEMENT STRATEGIES FOR GROUP-HOUSED SOWS

In practice, group housing actually refers to a variety of housing systems and management options, ranging in complexity from floor feeding to electronic sow feeders (ESF), group sizes from four to several hundred, and mixing sows at weaning through to sometime after pregnancy is confirmed (Arey and Edwards 1998; Spoolder et al. 2009). Even within the same housing system, different management options may affect the performance and well-being of sows greatly.

A study at the Prairie Swine Center in Saskatoon SK Canada indicated that social management and stage of gestation at mixing can affect the performance of gestating sows in a group housing system with ESF. The social management represented stable social groups (static groups) and unstable social groups (dynamic groups). The management of gestation stage at mixing included mixing sows before vs. after embryo implantation. Concurrent results from sows managed in stalls were provided for reference. Multiparous sows (n = 1,569 sow records, Parity 1 to 9, PIC genetics) from 100 contemporary breeding groups were used. Group-housed sows (n=1,112 sow records) were assigned to a 2×2 factorial arrangement of management treatments. Each static group consisted of 35 to 40 sows that were grouped simultaneously and no further sows were added to the group. Dynamic groups consisted of 105 to 120 sows, with 35 to 40 sows being added to the group every 5 wk after the same number of sows had been moved out for farrowing. Results indicate that social management did not affect farrowing rate and weight change during gestation (Table 1). However, sows in static pens sustained fewer (P = 0.01) skin lesions (cuts, swellings, and wounds) and had less incidence (P = 0.01) of lameness before farrowing than sows in the dynamic pen. Pre-implant sows had a lower farrowing rate (82.3% vs. 86.7%, P = 0.05; Table 1), but had fewer skin lesions before farrowing (P < 0.01) compared with post-implant sows. Neither social management nor stage of gestation at mixing affected total born, born alive or still born litter sizes. In general, sows group-housed with ESF performed similar to but sustained fewer skin lesions before farrowing than sows in stalls. These results demonstrate that management options can affect the reproductive performance and injuries of gestating sows in the ESF system.

Aggression among unfamiliar pigs is necessary to develop a dominant hierarchy within a group; so, aggression among sows at mixing cannot be eliminated completely (Krauss and Hoy 2011). However, it is important to protect vulnerable sows and eliminate severe injuries caused by aggression in group-housing systems. Young sows are vulnerable in a group because they usually lose most fights and suffer more injuries than mature sows at mixing. In most production systems, gilts are usually housed separately in group housing systems to prevent aggression from older sows (Luescher et al. 1990; Spoolder et al. 1997). After the first farrowing, 1$^{st}$ parity sows are usually housed in pens with older sows (Strawford et al. 2008; Li et al. 2011). Average body weight of 1$^{st}$ parity sows is 25% less than the body weight of mature sows (Li et al. 2010), and is more similar to the body weight of gilts than mature sows. So, it may be appropriate to house 1$^{st}$ parity sows with gilts rather than with mature sows to reduce social stress. At the University of Minnesota, we investigated effects of sorting by parity on aggression, associated stress and performance of young sows in a group-housed gestation system. In this study, sows and gilts (n = 180) from 6 breeding groups were used. Within each group, two groups of 15 females were mixed in each of two treatment pens after weaning, and remained there throughout the entire gestation period. The control pen consisted of 11 multiparous and four 1$^{st}$ parity sows; and the treatment pen consisted of 11 gilts and four 1$^{st}$ parity sows. Before mixing and at the end of the gestation period, sows and gilts were weighed individually, assessed for body condition scores, and measured for back fat thickness. Injury scores were assessed before and 48 h after mixing, and wean-to-mating intervals, farrowing rate, and litter performance at the subsequent farrowing were recorded for all females. Aggressive interactions involving 1$^{st}$ parity sows were video-recorded for 72 h immediately after mixing in each pen. Results indicate that all females in treatment pens (Gilt Pen) sustained fewer scratches ($P$ = 0.01; Table 2) after mixing than females in control pens (Sow Pen, Table 2). First parity sows in treatment pens had fewer injures ($P$ = 0.01) after mixing, gained more weight ($P$ = 0.02) during the gestation period, and had higher farrowing rates ($P$ = 0.03) compared with 1$^{st}$ parity sows in control pens. The results suggest that sorting by parity shielded 1$^{st}$ parity sows from severe injuries caused by mixing-induced aggression so that their welfare and performance can be improved in group housing systems.

In summary, group-housing systems can improve well-being of sows when individual feed intake of sows is controlled and aggression among sows is minimized. The selection of feeding systems, such as the ESF and free-access stalls, can help control individual feed intake so that sows can maintain desired body condition. Management options, such as mixing sows after pregnancy confirmation, keeping sows in static groups, and sorting by parity, can reduce aggression-associated injuries which will improve well-being and performance of group-housed sows.

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**Table 1. Reproductive performance of sows in an electronic sow feeder (ESF) system with different management options**

| Item | Static | | Dynamic | | Stalls | Pooled | *P* - values | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | Pre[Z] | Post[Y] | Pre | Post | | SE | SOCIAL[X] | IMPL[W] | SOCIA×IMPL | STALL INCLUDED[V] |
| # of sows bred | 332 | 226 | 262 | 292 | 457 | - | - | - | - | - |
| Parity | 4.2 | 3.8 | 3.2 | 3.6 | 3.6 | - | - | - | - | - |
| Farrowing rate,% | 82.5[a] | 85.0[b] | 82.1[a] | 88.0[b] | 86.2 | - | 0.61 | 0.05 | - | 0.20 |
| Gestation length, d | 114.5 | 114.6 | 114.5 | 114.4 | 114.6 | 0.16 | 0.63 | 0.78 | 0.65 | 0.74 |
| Weight, kg | | | | | | | | | | |
| After breeding | 218[a] | 211[ab] | 217[ab] | 208[b] | 217 | 3.3 | 0.52 | 0.01 | 0.91 | 0.12 |
| Before farrowing | 286[A] | 277[AB] | 285[AB] | 273[B] | 283[AB] | 3.6 | 0.40 | <0.001 | 0.84 | 0.04 |
| Change during gestation | 68.2 | 65.6 | 68.1 | 64.4 | 66.1 | 2.27 | 0.81 | 0.15 | 0.90 | 0.72 |
| Litter size farrowed, pigs/litter | | | | | | | | | | |
| Total born | 11.9 | 12.2 | 12.1 | 12.1 | 12.0 | 0.22 | 0.80 | 0.60 | 0.62 | 0.86 |
| Born alive | 10.8 | 11.1 | 11.0 | 11.0 | 10.8 | 0.21 | 0.79 | 0.62 | 0.63 | 0.83 |
| Still born | 0.8 | 0.7 | 0.9 | 0.8 | 0.9 | 0.10 | 0.32 | 0.56 | 0.85 | 0.82 |

[Z] Pre is an abbreviation of Pre-Implantation of embryos, which was between 2 and 9 d after breeding.

[Y] Post is an abbreviation of Post-Implantation of embryos, which was between 37 and 44 d after breeding.

[X] The P-value refers to the effect of Static vs. Dynamic social management.

[W] The P-value refers to the effect of Pre- vs. Post-Implantation of embryos.

[V] The P-value refers to the five treatment effects: Static Pre-Implantation, Static Post-Implantation, Dynamic Pre-Implantation, Dynamic Post-Implantation, and Stall. There were no interactions between treatment and parity (all $P > 0.10$).

[a,b] Represent effect of management options for the ESF system. Means within a row without a common superscript differ ($P < 0.05$).

[A,B] Represent effect of the five treatments, including Stall. Means within a row without a common superscript differ ($P < 0.05$).

**Table 2.** Performance of sows and gilts in a group-gestation housing system

| | SOW PEN[1] | | GILT PEN[2] | | | |
|---|---|---|---|---|---|---|
| | Old Sows[3] | Young Sows[4] | Gilts[5] | Yong Sows | Pooled SE | *P* - value |
| Number of animals | 66 | 24 | 66 | 24 | - | - |
| Farrowing rate, % | 88.5 | 66.7 | 85.5 | 94.7 | 6.80($\chi^2$) | 0.08 |
| Litter size, piglets/litter | | | | | | |
| Total born | 11.8 | 11.6 | 11.7 | 11.3 | 0.46 | 0.94 |
| Born alive | 11.1 | 10.3 | 11.1 | 10.7 | 0.47 | 0.85 |
| Still born | 0.7 | 1.2 | 0.5 | 0.5 | 0.2 | 0.45 |
| Body weight of sows, kg | | | | | | |
| At mixing[6] | $264^{a}$ | $207^{b}$ | $169^{c}$ | $201^{b}$ | 5.7 | <0.001 |
| Before farrowing[7] | $299^{a}$ | $235^{bc}$ | $230^{c}$ | $256^{b}$ | 7.0 | <0.001 |
| Gain[7] | $36^{ae}$ | $34^{ae}$ | $62^{b}$ | $58^{bf}$ | 5.9 | 0.02 |
| Injury scores after mixing[6,8] | | | | | | |
| Head and shoulders[9] | $4.21^{ab}$ | $5.10^{b}$ | $3.44^{a}$ | $4.93^{b}$ | 0.44 | 0.01 |
| Body[10] | $3.74^{a}$ | $7.06^{b}$ | $2.22^{c}$ | $2.81^{ac}$ | 0.452 | 0.01 |
| Total[11] | $7.98^{a}$ | $12.02^{b}$ | $5.70^{c}$ | $7.81^{a}$ | 0.692 | 0.01 |

[a-c]Means within a row with different superscripts differ (P < 0.05).
[e,f]Means within a row with different superscripts tend to differ (P < 0.10).
[1]Each sow-pen consisted of four parity 1 sows and 11 multiparous sows (parity 2 to 10).
[2]Each gilt-pen consisted of four parity 1 sows and 11 gilts.
[3]Old sows were multiparous sows (parity 2 to 10).
[4]Young sows were parity 1 sows.
[5]Gilts were females that were in their first pregnancy.
[6]Data were collected on all females that were moved to the gestation pens. Injury scores were assessed 48 h after mixing in gestation pens; and the injury scores before mixing was used as a covariate.
[7]Data were collected on females that farrowed.
[8]Injury score system used: 0 = no injury (skin unmarked); 1 = minor injury (less than 5 superficial wounds); 2 = obvious injury (5 to 10 superficial wounds or up to 3 deep wounds or both); 3 = severe injury (more than 10 superficial wounds or more than 3 deep wounds or both).
[9]For the purpose of injury assessment, body surface was imaginarily divided into 12 regions: the snout, 2 ears, 2 shoulders, 2 flanks, 2 hindquarters, the back, tail, and vulva. An injury score for head and shoulders was calculated by combining injury scores for the snout, 2 ears and 2 shoulders, with a maximum possible score of 15.
[10]An injury score for the body was calculated by combining injury scores for 2 flanks, 2 hindquarters, the back, the tail, and the vulva, with a maximum possible score of 21.
[11]A total injury score was calculated by adding injury scores for the 12 regions, with a maximum possible score of 36.