Studies on Housing of Pregnant Sows in Groups and Individually

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1. Summary

- Intensive methods of sow housing and their effects on health and welfare have become a topic of intense debate. In the EU the use of tethers for pregnant sows must be phased out by 2006. At present there are no plans to ban stalls for pregnant sows. In 1997 the EU released a report on sow housing which was critical of stalls but did not recommend a ban (SVC, 1997). Some member countries have introduced more stringent legislation. The UK government has banned the use of both stalls and tethers for pregnant sows from January 1, 1999. Sweden has also imposed a ban on both stalls and tethers, and the Netherlands and Denmark have announced restrictions on when individual penning may be used.

- This study included a comparison of pregnant gilts in loose housing (groups of 4) and in individual stalls from early pregnancy. Behaviour and skin lesions were monitored both during pregnancy and in the farrowing house. Stalled gilts tended to have higher skin lesion scores. Salivary cortisol levels in stalled gilts showed evidence of a chronic stress response. Loose gilts showed more distress when confined in the farrowing crate pre-farrowing than did gilts which had been housed in stalls in pregnancy.

- Comparison of two group housing systems namely, groups of four with 3.0m^2 per sow and groups of eight with 2.2m^2 per sow showed a higher level of aggression in the larger group. Both treatments had free-access stalls with full length partitions but the groups of eight had a smaller communal lying area and they spent a greater proportion of their time in the stalls.

Due to increasing sow body sizes, the dimensions of gestation stalls may need to be revised

2. Introduction

- Intensive methods of sow housing and their effects on health and welfare have become a topic of intense debate. In the EU, use of tethers for pregnant sows must be phased out by 2006. At present there are no plans to ban the use of sow stalls in pregnancy. In 1997 the EU released a report on sow housing which was critical of stalls but did not recommend a ban (SVC, 1997). Some member countries have introduced more stringent legislation. The UK government has banned the use of both stalls and tethers from January 1, 1999. Sweden has also imposed a ban on both systems and Netherlands and Denmark have announced restrictions on when individual penning may be used.

- The merits of different sow housing systems have been discussed by Lynch (1995 and 1998). The main criticisms of individual sow housing systems are that the animals are unable to turn, unable to exercise and have little opportunity to perform social behaviours. In contrast, housing in groups allows sows to exercise, to select their resting area and offers social companionship. However, the damage

that sows in groups can, inflict on each other through fighting, gives rise to other welfare concerns.

- Rushen (1996) cautioned that alternative housing systems may not improve animal welfare and that changing housing systems often results in switching one set of welfare problems for another. This is supported by reports from the UK which indicate that the systems permitted under the new regulation have resulted in a range of new welfare problems (Smith, 1997). In a long term, Dutch comparison of group and individual penning systems for pregnant sows, a high level of injuries from fighting was recorded in group housed sows (Backus et al., 1997).

- Floor types in the farrowing house have changed over the years from straw bedding on concrete to fully slatted floors or combinations of solid floors and slatted panels made of concrete, cast iron, metal or plastic. The use of perforated floors in the farrowing house is now standard practice in Ireland although some reports from abroad indicate that these materials had disadvantages in terms of sow and piglet comfort (DS 1992; DS 1993). Aspects of production,behaviour and lesion development in sows and piglets housed on some of these surfaces have been documented (Edwards and Lightfoot, 1986: Furniss et al., 1986; Quemere et al., 1988; Phillips et al., 1995).

- A balance must be achieved between the need to provide adequate purchase for the sow to stand and lie without slipping and the detrimental effects of a floor which is too abrasive (Furniss et al., 1986). According to Svendsen et al., (1986) as many as one-third of all deaths in piglets was due to crushing, within the first 72 hrs of birth. Piglets are strongly motivated to stay at the udder and therefore risk being crushed as the sow changes posture from standing to lying (Cronin and Cropley, 1991). Most crushing incidents occur beneath the hind quarters of the sow (Svendsen et al.,1986).

- In any farrowing system, hygiene is very important. Slatted floors minimise contact of the animals with faecal material and allow for effective washing and disinfecting between batches which helps in maintaining the health of new-born pigs.

3. The effect of two housing systems on skin lesions, behaviour and psysiological responses of pregnant gilts

- It may be expected that gilts entering the herd for the first time may adapt more readily to penning in groups since this is the system in which they have been reared and that gilts may also show a more negative reaction to first confinement in stalls. The objective of this study was to compare loose housing systems with bedding with individual penning for gilts during their first pregnancy.

3.1 Materials and Methods

- Thirty-eight gilts were selected (c. 28 days post-service) on the basis of service date and allocated to two treatments: (1) ST - Stalls (n=23) - part slatted concrete floored stalls (2.0m x 0.6m); (2) LB - Loose bedded pens (3.1 x 2.6 m) in familiar groups of four (n=15) with peat moss bedding and a slatted dunging area.

- Gilts were inspected for skin lesions on Days 0, 2, 8, 31 and the day before entering the farrowing house (Day 0FH). Skin lesions were scored according to severity (0 to 6) using a method adapted from de Koning (1985). Behaviour of each gilt was recorded continuously for 1 minute every 5 minutes during the first hour in each treatment. When the gilts were approx. 75 days pregnant c. 1.5mls of saliva was collected by allowing the gilts to chew on cotton wool buds at 0900h. Immediately after, 200i.u. of ACTH (Synacthen, CIBA) was administered intramuscularly to the gilts (ST: n=14 and LB: n=11). Saliva collections were made 0.5, 1.0, 1.5 and 2.0 hours post injection. Salivary cortisol was measured using 'Cortisol Coat-A-Count' kits (Cruinn Diagnostics Ltd). The use of salivary cortisol has been validated in the pig (Parrot et al., Br. Vet. J. 145, 1989) and avoids the need for stressful blood collection.

3.2 Results

- There was no significant difference between the lesion scores of gilts in the two treatments at Day 0, however at each subsequent inspection ST gilts had significantly higher lesion scores (Table 3.1). Total and severe scores of ST gilts increased significantly after 24 hours and continued to increase though not significantly, at each subsequent inspection. There were no significant increases in the lesion scores of LB gilts at each inspection, however the total score at Day 31 was significantly lower than at Day 0 FH.

Table 3.1 : Median, minimum and maximum total and severe* lesion scores at each inspection (* calculated by addition of only those scores >2)

	Total Lesion Score		Severe Lesion Score	
Inspection	Stall	Loose Bedded	Stall	Loose Bedded
Day 0	12 (0-25)^{1}	10 (2-24)	0 (0-15)^{1}	0 (0-12)
Day 2	^{a}15 (2-34)^{2}	^{b}10 (2-19)	^{a}6 (0-23)^{2}	^{b}0 (0-6)
Day 8	^{a}23 (10-36)^{3}	^{b}10 (2-19)	^{a}7 (0-24)^{2}	^{b}0 (0-6)
Day 31	^{a}21 (12-33)^{3}	^{b}10 (2-18)^{1}	^{a}6 (0-21)^{2}	^{b}0 (0-6)
Day 0 FH	^{a}22 (12-34)^{3}	^{b}12 (4-16)^{2}	^{a}6 (0-21)^{2}	^{b}0 (0-6)

^{a,b} **Differences between columns are significantly different (P < 0.05)**
^{1,2,3} **Differences between rows are significantly different (P < 0.05)**

Gilts housed in gestation stalls have higher skin lesion scores than gilts housed in loose pens.

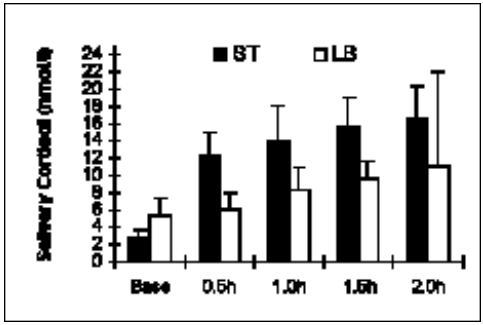
- During the first hour of the experiment ST gilts made significantly more turn and escape attempts than the LB gilts (P<0.001) (Table 3.2). In the LB treatment these behaviours were not observed. The ST gilts also defecated, slipped, grunted, squealed and were bar biting significantly more than the LB gilts (P < 0.001). The LB gilts rooted the floor significantly more than the ST gilts (P < 0.001).

Table 3.2 : Median, minimum and maximum behaviour of gilts per minute during the first hour in each treatment

Behaviour	Stall		Loose Bedded	
Escape attempt	0	(0 - 0.3) [a]	0[b]	
Turn attempt	0.4	(0 - 1.7) [a]	0[b]	
Defecate	0	(0 - 0.3) [a]	0[b]	
Bar bite	0.4	(0 - 2.5) [a]	0	(0 - 0.4)[b]
Root floor	0.4	(0 - 6.4) [a]	2.8	(1.2 - 3.1)[b]
Grunt	3.3	(0 - 7.8) [a]	0.3	(0 - 1.3)[b]
Squeal	0	(0 - 3.7) [a]	0[b]	
Slip	0.1	(0 - 1.8) [a]	0	(0 - 0.1)[b]

[ab] Differences between columns are significantly different (P<0.001)

LB gilts had higher pre-ACTH (baseline) salivary cortisol concentrations (P<0.01) (Figure 3.1). However, at each sampling time-point after the ACTH challenge the ST gilts had significantly higher salivary cortisol concentrations (P< 0.001).



"Effect of treatment at Day 35 on salivary cortisol concentrations (Nml-1) prior to intramuscular injection with ACTH (base) at 0.5h,1.0h, 1.5h, and 2.0h post-injection"

3.3 Discussion and Conclusions

- The behaviour of the ST gilts during the first hour in the stalls was similar to that described by Cronin (1985) for gilts tethered for the first time and suggests that their first experience of close confinement was stressful. The struggling of the ST gilts combined with slipping on the concrete floor was responsible for the increase in the skin lesion score observed at Day 2. It may be that ease of movement deteriorates as pregnancy progresses in stall housed gilts due to their increasing size. This could explain the increases in the lesion scores observed in ST gilts as the experiment progressed. In contrast no increase in either the total or severe lesion score was observed in the LB gilts. This is partly due to the fact that these animals did not undergo a struggle during their first hour in the new environment and subsequently did not have their ability to manoeuvre hampered by diminishing space. Furthermore, as the gilts were put on treatment in familiar groups of four there was no skin damage due to the fighting that normally occurs at mixing. Finally, the peat moss bedding, as well as providing a substrate to root in, also provided a cushioning effect from the floor thereby protecting the skin from damage. The salivary cortisol concentration of the ST gilts following ACTH challenge increased more rapidly and to a greater extent then the LB gilts which indicates that the ST gilts exhibited a chronic stress response.

- The findings of this study suggest that the welfare of pregnant gilts may be improved by housing in groups. Housing in familiar groups on bedding minimises damage to the skin and ensures that gilts are not under chronic stress.

4. The effect of housing system during gestation on behaviour and skin lesion scores of gilts in the farrowing house

- Sows housed in groups during gestation may have poorer welfare when confined at farrowing according to Marchant and Broom (1993). The aim of this study was to evaluate the effect of three gestation housing systems on behaviour and skin lesions of gilts in farrowing crates.

4.1 Materials and Methods

- Fifty-two gilts were allocated to one of three gestation housing treatments: (1) Stalls (ST) with part-slatted concrete floor, (2) Loose bedded (LB) - familiar groups of four gilts on peat moss bedding (3) Loose unbedded (LU) - familiar groups of four gilts on part-slatted concrete. Five days before predicted farrowing date gilts were moved to conventional farrowing crates with metal slatted floors (Tri-Bar, Nooyen BV, Deurne, Netherlands). Behaviour was recorded by direct observation for the first hour in the crate and time-lapse video recordings were made for 24 hours on day 1 and day 8 (approx. 24 hours post-partum). Gilts were examined at 34 locations for skin lesions the day before entry to the farrowing house (0FH), 2 days later (2FH), each week of lactation (WK1, WK 2, WK3) and at weaning (WEAN). Lesions were scored according to severity (1 to 6); addition of all scores yielded a total lesion score for each gilt. Addition of all scores of 3 or greater yielded a severe lesion score for each gilt. The method used for scoring lesions was adapted from de Koning (1985). Mann-Whitney tests were performed on the data (SAS, 1989).

4.2 Results

- LB gilts showed most signs of agitation during the first hour in the farrowing crate (Table 4.1). The number of posture changes were not different between treatments on Day 1 but on Day 8 the LU gilts made significantly more posture changes than the ST gilts (median, min-max. 99 (74-162) vs 58 (37-131); $P<0.001$).

Table 4.1 : Median (min.-max.) of behavioural activities per observation during first hour in the farrowing house

	ST	LB	LU	P
Standing	26.1 (7.1-57.4)[a, b]	18.5 (3.5-51.3)[a]	31.8 (15-56.8)[b]	0.007
Walking	0.7 (0-1.6)[a]	1.8 (0-6.5)[b]	1.0 (0-4.1)[a, b]	0.01
Attempts to turn	0 (0-0.7)[a]	0.4 (0-2.3)[b]	0.2 (0- 1.3)[a, b]	0.01
Grunt	6.7 (1.6-20.9)[a]	3.3 (0.1-11.3)[b]	4.3 (0.3-9.1)[a, b]	0.02

- At the 0FH inspection there were significant differences in the total and severe skin lesion scores between the three treatments (Table 4.2 and 4.3) but, taking the 0FH inspection value as a covariate, there were no significant differences between treatments in the total lesion score at each subsequent inspection (P>0.05). However, the LB gilts had significantly lower severe lesion scores than ST gilts at weaning (Table 4.3). The increases in both the total and severe lesion scores after farrowing (i.e. WK1) were significant for gilts in both loose treatments but not for the stall housed gilts (P<0.001).

Table 4.2 : Median (min.-max.) total lesion scores at each skin inspection in the farrowing house

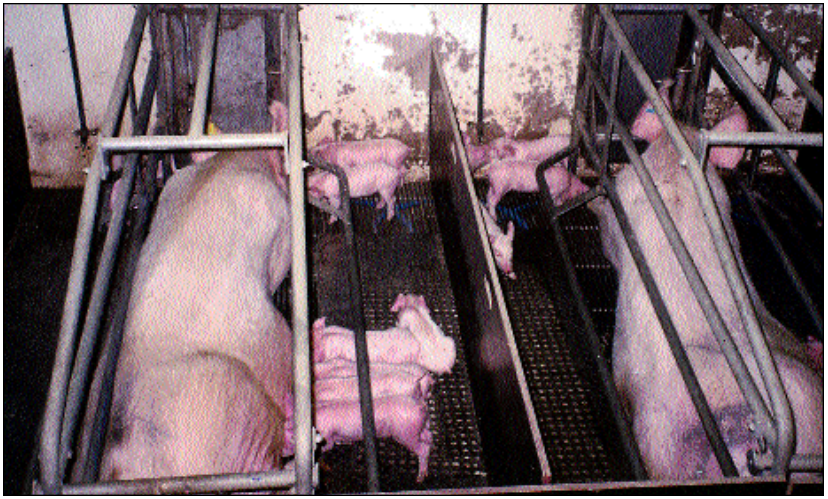
	O FH	2 FH	WK 1	WK 2	WK 3	WEAN	P
ST	[1]22(12-34)	28(14-41)	25 (18-56)	26(19-55)	26(16-40)	29(21-46)	NS
LU	[2]18(10-22)[a]	21(12-32)[ab]	26(18-33)[b]	24(12-35)[b]	24(12-32)	[b]27(15-31)[b]	***
LB	[3]12(4-16)[a]	15(4-22)[ac]	21(12-41)[b]	2(17-30)[b]	9(12-30)[b]	9(12-29)[bc]	***

[a,b,c] **Differences between columns are significantly different (P<0.001)**
[1,2,3] **Differences between rows are significantly different (P<0.001)**

Table 4.3 : Median (min.-max.) severe skin lesion scores at each inspection in the farrowing house

	0 FH	2 FH	WK 1	WK 2	WK 3	WEAN	P
ST	[1]6(0-21)	12(0-27)	12(3-38)	13(3-33)	8(0-23)	[1]13(3-33)	NS
LU	[2]2(0-9) [a]	6(0-6)[ab]	14(3-23)[b]	9(0-20)[b]	9(0-12)[b]	[1,2]9(3-18)[b]	***
LB	[2]0(0-6) [a]	4(0-12)[ab]	8(0-32)[b]	9(0-13)[b]	6(0-13)[b]	[2]5(0-13)[ab]	***

[a,b,c] Differences between columns are significantly different (P<0.001)
[1,2,3] Differences between rows are significantly different (P<0.001)



Loose-housed gilts experience greater distress when confined at farrowing than gilts penned individually during pregnancy

5. Evaluation of a simple conversion option for housing pregnant sows in groups of eight

- The objective of this trial was to evaluate a conversion option which would suit some existing stall or tether buildings of moderate internal width i.e. approximately 6 metres for two rows of sows facing away from one another, and to compare this design with a typical four sow free access stall system.

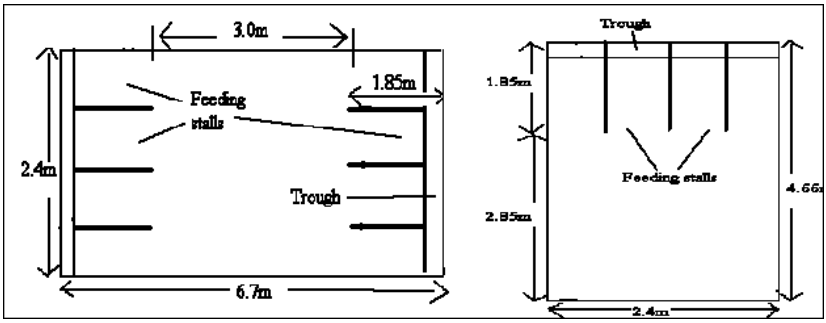
5.1 Materials and Methods

- The layout of the two designs is shown in Figure 5.1. Multiparous sows (F1 – Landrace * Large White or Hyshan 8 supplied by Hermitage AI, Kilkenny) were housed in groups of 4 and 8, in fully-slatted pens, with full-length, feeding stalls without rear gates (= free access stalls), from 3 to 5-weeks post-service, for a one-month trial period. Sows were selected at this stage as it was felt that this is the ideal time for mixing sows which would benefit from individual attention post-weaning and being past the three week repeat check the groups should not be upset by oestrus in individual animals. A one month trial period was selected as firstly, it was felt that the first month would be the period when aggression would be most intense and secondly, it allowed a number of batches of sows to be studied within the time span of 8 months which was proposed for the study.

- In total, eight batches of sows in each group size were observed. These sows had been kept in stalls in previous pregnancies, and from the mating prior to the trial, and were returned to stalls after the trial ended. The space allowance in groups of four was 2.8m^2 (30ft^2)/sow, and 2.0m^2 (22ft^2)/sow in groups of eight. The layout with eight sows represented a possible conversion option in a house currently holding two rows of stalls (though wider than most such houses).

Figure 1. Pen designs (drawings not to scale)

A. Group size 8 **B. Group size 4**



5.2 Results and Discussion

5.2.1 Mixing

- There are suggestions that it is preferable to mix sows on slatted floors than on solid floors, as sows are reluctant to prolong conflicts with the less sure footing which slats provide (Walker and Beattie, 1994). However, fighting on slats can lead to serious foot injuries, and in some cases, the necessity to cull injured sows.

- For this reason, the slatted common area in the pens used in our trial was covered with rubber mats (R.J. Mooney & Sons, Ltd., Longmile Road, Dublin) for the first 24-hours after mixing. The mats did appear to offer some protection to the sows while the dominance hierarchy was being established, as only one sow, out of a total of 96, which were housed in groups, was removed for lameness. However, this effect should be qualified by further experimentation. None of the sows repeated during the trial period.

5.2.2. Aggression

- Neither the frequency, nor the severity, of fights differed between sows in groups of four or eight, on the day of mixing, or throughout the housing period. However, as sows in groups of four had more space to escape from a fight, their skin damage scores were significantly lower than sows in groups of eight, at all inspections (Table 5.1). Many sow houses with tether systems are significantly narrower than the 6.7m-wide house used here for the groups of eight, and have a floor area as low as 1.5m^2/sow. Removal of the tethers, and leaving the same number of sows in the area, is likely to result in a high incidence of aggression and injuries which could lead to increased culling and reduced fertility.

- Skin damage scores in both treatments did not decrease significantly until day 21, which indicates that aggression remained high in both treatments for at least the first two weeks.

Table 5.1 : Skin damage-scores (mean ± SEM) of sows in groups

	Group 4	Group 8	P
Day 1	8.7 ± 1.7	15.7 ± 1.9	*
Day 7	8.5 ± 1.1	14.4 ± 1.4	*
Day 14	6.7 ± 1.0	10.9 ± 0.8	**
Day 21	4.9 ± 3.1	6.5 ± 1.1	NS
Day 28	3.1 ± 0.8	5.5 ± 0.6	*
Total	6.4 ± 0.6	10.6 ± 0.9	***

Scores (1 to 5, depending on severity) were recorded on 12 body locations; the maximum score possible was 60.

5.2.3 Use of Loose Area and Feeding Stalls

- Beattie and Walker (1999) found that sows housed in free-access stalls prefer to lie together in a communal lying area, especially when straw is provided. However, sows which have previously been kept in stalls in gestation, tend to spend more time in the feeding stalls than in the loose area when transferred to group-housing with free-access stalls (Walker and Kilpatrick, 1994). The sows in the current experiment had previously been housed in stalls, and familiarity with this system was expected to result in low usage of the loose area, initially, but to increase over time.

- Sows in fours did show an increase in the proportion of time spent in the loose area, as the trial progressed, but this was not the case with the groups of eight. On each observation-day, sows in groups of four spent significantly more time in the loose area than sows in groups of eight (Table 5.2). This is likely to be a reaction to the lower floor space allowance in groups of eight.

Table 5.2 : Percentage (mean ± SEM) of observations that sows spent in the loose-area

	Group 4	Group 8	P
Day 1	41.2 ± 11.0	11.1 ± 4.0	*
Day 7	56.4 ± 7.9	11.4 ± 3.2	***
Day 14	71.8 ± 10.3	9.1 ± 2.8	***
Day 21	66.9 ± 5.4	22.4 ± 6.1	***
Day 28	70.4 ± 5.4	20.1 ± 6.7	***
Total	59.2 ± 3.9	14.9 ± 2.2	***

Percentage of observations over the six-hour period during which sows were observed (08:00-10:00; 11:00-13:00, and 15:00-17:00)

Sows in groups of 4 tended to increase the amount of time lying in the loose area as the experiment progressed. This was not the case for sows on groups of 8.

5.2.4 Feeding Behaviour

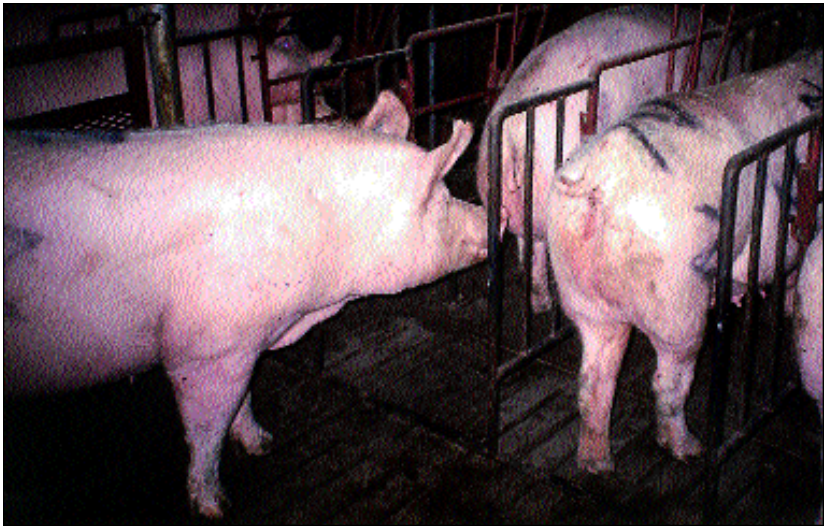
- Observations at feeding showed no instances of sows swapping places or displacing others. This was probably due to the presence of full-length stalls, and the fact that the sows were wet-fed, both of which have been shown to reduce aggression (Bøe et al., 1999). However, after feeding had finished, swapping of stalls was common, but was not accompanied by aggression. While some sows seemed to spend almost all of their time in the same stall, the majority of sows showed no consistency in their use of particular stalls for feeding.

- Work in Northern Ireland compared stall divisions of 0.5m, 1.0m and 2.0m length (Walker and Beattie, 1994). With shorter partitions, fewer sows consumed their exact daily feed allocation and there were more voluntary and more enforced withdrawals from stalls during feeding.

5.2.5 Sow Longevity

- The trial reported here was too small to detect differences in sow performance or culling. In another study of sows housed individually on commercial farms, we have seen a significant number of broken or amputated claws which progress to severe lameness. Fighting amongst mixed sows on fully or partially-slatted floors, without bedding, is likely to lead to a high incidence of such problems. Sows in groups tend to move about more, and in a trial in the U.K., were found to have better muscle and bone development (Marchant and Broom, 1996) and improved cardiovascular fitness (Marchant and Rudd, 1993). Therefore, being more "physically fit", group-housed sows are likely to be more agile in the farrowing crate, with possible benefits to piglet mortality, and feeding behaviour.

- They may also have a longer productive life, helping to offset the increased housing costs as a result of a higher space allowance.



Stall swapping during feeding is not a major problem with free-access stall systems

Full-length feeding-stalls and space allowances of c.3.0m2/ sow work for sows in groups of 4

6. Conclusion

- The findings of the comparison of loose and individual penning in pregnancy suggest that both the short and long term welfare of pregnant gilts may be best when housed in groups. Housing in familiar groups on bedding minimises damage to the skin and reduces chronic stress.

- Behaviour of the loose bedded gilts indicates that they were the most distressed group during the first hour in the farrowing crate. However, the stall housed gilts grunted significantly more than gilts in other treatments suggesting that they too were affected by the change in environment. The increase in skin lesion score recorded in both groups of loose housed gilts after farrowing and the restlessness of the LU gilts after farrowing suggests that loose housed gilts experienced greater frustration at farrowing than the stall housed gilts. The beneficial effect of bedding on skin health during gestation persisted the LB gilts at the WEAN inspection.

- Simple conversion of existing stall or tether housing, with minimal alterations and floor-area of c.2.2m2 per sow, is likely to result in high levels of aggression and skin damage. A system based on groups of four sows, with c.3.0m2 per head, with long divisions and free access to stalls, appears to work well, even with older sows accustomed to stalls. Improved physical fitness in group-housed animals may lead to improved sow longevity.

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