

Effect of Lactation Environment on Behaviour of Suckling Piglets

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To investigate the effect of the pen on the welfare of suckling piglets by comparing the behaviours of piglets in either crates or straw enriched pens, sixteen litter piglets in crates or straw enriched pens were used in the present experiment. In the 2–5 weeks after birth, the behaviours of suckling piglets from 07:00 to 9:00 and 13:00 to 15:00 on the third and sixth day of each week were observed to compare between different environments. The results showed that a straw pen can significantly reduce piglets' directed behaviour toward penmates and the pen ($p < 0.01$), while piglets in crates had more standing ($p < 0.01$) and manipulating ($p < 0.05$), and fewer walking ($p < 0.01$) and lying ($p < 0.05$) behaviours. In straw pens, social interaction, straw-manipulating, manipulating in general, and non-sucking activities of piglets reached a peak in W3 ($p < 0.05$). In the crate, walking in piglets decreased with age ($p < 0.05$). Moreover, in the crates, piglets performed more lying, and less standing and walking in the morning observation period ($p < 0.01$), and all activity increased ($p < 0.01$) except suckling behaviour in the afternoon observation period, but there was a significant difference in only suckling behaviour for straw pen piglets ($p < 0.01$). In conclusion, straw reduced manipulating in suckling piglets toward the pen or penmates. Adding straw in suitable periods for suckling piglets could improve the behaviours of piglets.

1. Introduction

Straw is widely used as an enrichment to improve pig welfare. Straw provides an outlet for exploratory and manipulative behaviour, such as rooting and chewing (Fraser et al., 1991). Compared to the bare environment, straw leads to less potential injurious social behaviour and more exploring behaviour (Fraser et al., 1991; Beattie et al., 1995, 2000; Kelly et al., 2000; Bolhuis et al., 2005). Piglets in straw pens are more active, and spend more time rooting and chewing straw (Pearce and Paterson, 1993; Kelly et al., 2000). Straw can also stimulate playing behaviour (Tuytens, 2005), because the increased unpredictability of the environment is very important for play (Špinková et al., 2001). For piglets in a semi-natural environment, playing behaviour peaks at 2–6 weeks (Newberry and Wood-Gush, 1988; Stolba and Wood-Gush, 1989). There is three times more playing behaviour in suckling piglets raised in straw pens than in a barren pen (Kelly et al., 2000; Bolhuis et al., 2005). Individual moving games, such as gambolling and circling, does not seem to have a direct relationship with the straw; however, such games differed significantly between pigs in rich and barren pens with the same space (Bolhuis et al., 2005).

However, most studies on piglets focused on a post-weaning enriched environment. Beattie et al. (1996) and O'Connell and Beattie (1999) found that the rates of manipulating and fighting behaviours in suckling piglets differed in different environments. Additionally, the early environment affected pigs' reaction to the environment in later life (Day et al., 2002). Because of the straw, the expanded space and more activities of sows in it, the lactation pen promoted playing in pre-weaning piglets, and greatly reduced fighting in food competition in later life (Chaloupková et al. 2007). Thus, providing an enriched pre-weaning environment can result in long-term benefits.

In the present study, the behaviours of suckling piglets in straw enriched pens or crates were observed to investigate the effect of the pen on the welfare of piglets.

2. Materials and methods

2.1 Animals and housing

Sixteen litters piglets (eight litters in the crate and eight litters in the straw enriched pen in the same room) with similar litter sizes (10.71 ± 2.81 vs. 10.57 ± 3.05 , $p = 0.929$) were used in the experiment. The piglets were weaned at 35 days of age.

The sows were fed three times per day at 06:00, 10:00, and 16:00. Piglet feed was offered to piglets from seven days of age. The straw pens were cleaned at 05:00 and 15:00 while the crates were cleaned at 06:00 and 16:00. Health inspection and treatment were performed at 06:30. Fresh straw for the pens were provided after the morning feeding each day.

Commercial farrowing crates (1800 mm \times 2150 mm) with a 600-mm wide stall in the middle were 0.3 m above the floor. Two thermal creeps (1000 mm \times 600 mm \times 500 mm) were fixed in the middle of the paired crates, and replaced by a stall at seven days of age. There were anti-crush bars (300 mm from above the floor and 200mm from the wall), straw-guard tubes (40 mm \times 60mm, 50mm from above the floor), and a steel frame creep (1000 mm \times 800 mm \times 1000 mm) in the straw pen (2100 mm \times 5700 mm).

2.2 Behavioural observations

In the 2–5 weeks after birth (W2, W3, W4, W5), the piglets were videotaped continuously from 07:00 to 9:00 and 13:00 to 15:00 on the 3rd and 6th day of each week, and instantaneous scans were performed by an experienced observer with a 5-min interval. The behaviours, categorized into posture and activity, are defined in Table 1.

Table 1: Behavioural categories and definitions of suckling piglet

Behavioural categories	Definitions
Posture	
Standing (still)	Maintaining an upright position on all four legs without locomotion.
Walking	Piglets are upright and lowly moving and running.
Lying	Chest and abdomen making contact with the floor, or one shoulder making contact with the floor.
Activity	
	Directed to pen
Manipulating	Directed to straw
	Directed to penmates
Suckling and massaging	
Social interaction	
Active	
Non-suckling activities	

2.3 Statistical analysis

IBM SPSS statistics 20 was used to analyse the behavioural data. The ratio of piglets in the litter that performed a specific behaviour was calculated as the frequency of behaviour of the sampling points. Non-suckling activities referred to the rate of activities excluding suckling. The effects of the environment, observation periods, and growing stages on behaviours were analysed using multivariate analyses, and correlation analyses were performed for growing stages and each behaviour. All the results of the statistical analyses are presented as mean \pm s.e.

3. Results

3.1 Behaviours in different growing stages

There were significantly more piglets lying ($p < 0.05$, $p < 0.01$, $p < 0.001$, $p < 0.05$) and standing ($p < 0.001$) in crates compared to in straw pens from W2 to W5, and significantly more piglets walking from W3 to W5 ($p < 0.05$, $p < 0.001$, $p < 0.001$; Table 2). As they aged, the number of piglets standing in the crates increased ($p < 0.01$), while the number of piglets walking decreased ($p < 0.05$) (Table 2).

Table 2: Effects of pen types on lying and walking in suckling piglets over by observational week

Posture	Stages	Crate (%)	Straw Pen (%)	p
Lying	W2	53.68 ± 4.20	66.42 ± 2.80	0.021
	W3	51.93 ± 3.65	64.72 ± 2.68	0.007
	W4	48.75 ± 3.41	67.51 ± 2.11	<0.001
	W5	52.08 ± 3.16	64.54 ± 3.32	0.027
Standing	W2	40.26 ^b ± 1.91	27.31 ± 2.07	<0.001
	W3	43.02 ^b ± 1.45	26.91 ± 1.47	<0.001
	W4	47.75 ^a ± 1.40	24.64 ± 1.52	<0.001
	W5	46.01 ^a ± 1.47	26.90 ± 2.33	<0.001
Walking	W2	6.06 ^a ± 1.10	5.93 ± 1.26	0.939
	W3	4.97 ^{ab} ± 0.75	7.97 ± 0.99	0.019
	W4	3.44 ^b ± 0.66	7.82 ± 0.94	<0.001
	W5	1.84 ^c ± 0.32	8.49 ± 1.55	<0.001

^{abc} Different letters in the same column denote significant ($p < 0.05$) differences between observational weeks.

The number of active piglets were significantly lower ($p < 0.05$) in the straw pens than in the crates from W2 to W5 (Figure 1). There were fewer suckling piglets in straw pens than in crates, but this difference was significant ($p < 0.01$) only at W3 (Figure 1); there were also significantly fewer non-suckling piglets in straw pens than in crates at W4 and W5 ($p < 0.001$, $p < 0.05$; Figure 1).

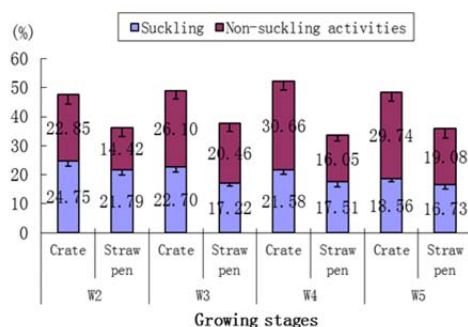


Figure 1: Effect of pen types on suckling and non-suckling activities in suckling piglets over time

There was significantly less social interaction among the piglets in the straw pens than in the crates at W4 and W5 ($p < 0.01$, $p < 0.05$; Figure 2); social interaction in the straw pen decreased significantly ($p < 0.05$) after W3 while there was no significant difference ($p > 0.10$) between weeks for the piglets in the crate (Figure 2). Compared to in the crates, significantly fewer ($p < 0.001$) piglets exhibited manipulating behaviour directly toward the pen or penmates in the straw pens from W2 to W5 (Figure 3). In the straw pen, more oral manipulating behaviour was directed to the straw ($p < 0.01$) rather than to the pen or penmates, and the number of straw-manipulating piglets and manipulating piglets in general were significantly fewer ($p < 0.05$) in W2 than in W3 (Figure 3). In the crates, pen-manipulating constituted most (about 80%) oral manipulating behaviour, and increased with age ($p > 0.05$, Figure 3). However, the number of manipulating piglets in the crates were significantly higher than that in the straw pen at W2 ($13.80 \pm 2.34\%$ vs $7.61 \pm 1.90\%$, $p = 0.05$), W4 ($19.23 \pm 1.95\%$ vs $9.80 \pm 1.34\%$, $p < 0.01$), and W5 ($18.58 \pm 1.90\%$ vs $11.38 \pm 2.49\%$, $p < 0.05$).

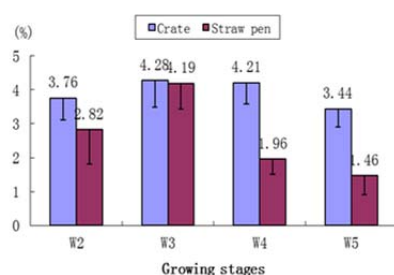


Figure 2: Effect of pen type on social interaction in suckling piglets over time

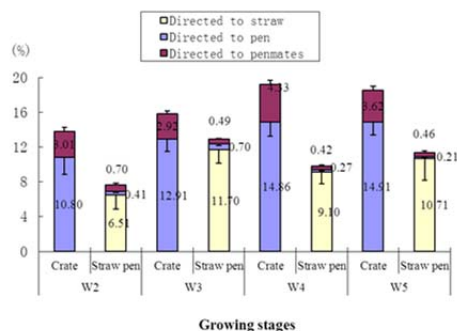


Figure 3: Manipulating behaviour in suckling piglets in the crates and pens over time

3.2 Behaviours in different observation periods

In the crates, there were significantly more piglets lying and fewer standing and walking in the morning period than in the afternoon ($p < 0.01$, Table 3); there were significantly more non-suckling piglets ($p < 0.01$) in the afternoon period in crates and significantly more suckling piglets ($p < 0.01$) in the morning period in the straw pen (Table 3). There were fewer social interactions and general activity ($p < 0.01$) in the crates in the morning than in the afternoon (Table 3). In the crates, there were significantly fewer ($p < 0.01$) piglets manipulating the pen or penmates in the morning than in the afternoon, and the number of manipulating piglets in the crates were significantly higher ($p < 0.01$) in the afternoon (Table 3).

Table 3: Effect of environment on behaviour of suckling piglets at different observation periods

Behaviour	Observing period	Crate (%)	Pen (%)
Lying	Morning	59.0 ^X ± 2.09	65.2 ± 1.76
	Afternoon	43.5 ^Y ± 2.45	66.7 ± 2.04
Standing	Morning	38.4 ^X ± 0.29	28.0 ± 1.2
	Afternoon	51.4 ^Y ± 1.0	24.3 ± 1.2
Walking	Morning	2.55 ^X ± 0.29	6.74 ± 0.77
	Afternoon	5.02 ^Y ± 0.62	8.57 ± 0.79
Suckling	Morning	20.4 ± 1.11	20.2 ^X ± 1.00
	Afternoon	22.5 ± 0.99	15.7 ^Y ± 1.05
Non-suckling activities	Morning	21.0 ^X ± 1.67	16.0 ± 1.71
	Afternoon	35.0 ^Y ± 2.14	19.4 ± 2.11
Activities	Morning	41.4 ^X ± 2.07	36.3 ± 1.76
	Afternoon	57.5 ^Y ± 2.49	35.2 ± 2.19
Social interaction	Morning	2.7 ^X ± 0.40	2.4 ± 0.40
	Afternoon	5.1 ^Y ± 0.48	3.1 ± 0.63
Manipulating straw	Morning	-	9.14 ± 1.15
	Afternoon	-	10.45 ± 1.23
Manipulating the pen	Morning	10.3 ^X ± 0.89	0.4 ± 0.14
	Afternoon	17.1 ^Y ± 1.17	0.4 ± 0.11
Manipulating penmates	Morning	3.1 ^X ± 0.33	0.3 ± 0.06
	Afternoon	3.9 ^Y ± 0.34	0.6 ± 0.11
Manipulating	Morning	13.5 ^X ± 1.13	9.9 ± 1.21
	Afternoon	21.1 ^Y ± 1.43	11.5 ± 1.31

^{XY} Different letters in the same column denote significant ($p < 0.01$) differences between observation periods

4. Discussion

Moinard *et al.* (2003) found that renewing the straw daily can reduce tail-biting in suckling piglets. However, there were few serious tail-biting in both environments in the present experiment. Additionally, few piglets in

the enriched straw pen performed behaviour directed to penmates or the pen—most oral behaviour were directed to the straw. Studies from Arey and Franklin (1995) and Petersen *et al.* (1995) also had similar results.

The study of Bolhuis *et al.* (2005) showed that, compared to the straw enriched environment, piglets reared in a barren environment were less active, performed less exploring, and spent more time engaging in oral behaviour directed toward penmates. However, in the present experiment, the piglets in the crates walked less, laid down less, stood more, and were more active than the piglets in the straw pen. That may be because more piglets in the crates performed more manipulating behaviour when lying and standing, most of which were directed to the pen and especially to the slatted floor. The high frequency of biting and rooting the floor suggest that the metal slats are more attractive in the barren environment.

In the present study, suckling behaviour increased with breast massaging in the piglets in the crates, which might be the result of less rejection of the dam, or the sow being regarded as a manipulating object (Petersen *et al.*, 1995). In the straw pens, suckling behaviour decreased from W3 and remained stable, and social interaction, straw-manipulating, manipulating in total, and non-sucking activities reached a peak in W3. The decreasing of manipulating behaviour in the straw pen might be due to familiarity with the straw environment. The less social interaction, general manipulating behaviour, and non-sucking activities in piglets in the straw pen in W4 and W5 also support this hypothesis. Thus, it is important for suckling piglets to be in an enriching environment in W3. Providing straw in the first two weeks of birth may have little impact on piglets; however, a study by Moinard *et al.* (2003) showed long-term effects of having straw in a farrowing pen on piglets' later behaviour, such as reducing tail biting later. Thus, future studies should investigate the appropriate stage at which to provide suckling piglets with straw in order to induce long-term effects on the social interaction, cognitive ability, and stress susceptibility of pig in later life.

The results also showed that walking behaviour in piglets in the crate decreased with age, while those in the straw pen maintained a high rate of walking, resulting in significantly more behaviours in the straw pen. This might be due to lack of walking space in the crate for the growing piglets. The unsatisfactory space was another reason for more manipulating behaviour in piglets in the crates in W4 and W5.

In addition, piglets in different environments showed different activity level in different observing period. In the crates, piglets performed more lying, and less standing and walking in the morning observation period. The piglets were more active in the afternoon observation period, showing more non-sucking activity, social interaction, pen-manipulating, and penmate-manipulating, with only suckling behaviour showing no significant difference. But there was a significant difference in suckling behaviour for straw pen piglets ($p < 0.01$) This may be because the piglets were more likely to be disturbed by the movement of the dams in the small space of the crates, and those sows were more active in the afternoon. Thus, providing sufficient space is beneficial for piglets in a barren environment.

5. Conclusions

Adding straw reduced suckling piglets' oral manipulating behaviour directed at the pen or penmates. However, the piglets were not active in the early days after birth, so effects of providing straw in the first two weeks require further investigations. The decrease in active behaviours in the straw pen after three weeks of age suggests that straw cannot fully meet the needs of the piglets even if there is enough space. Thus, adding straw during suitable periods for suckling piglets could reduce undesirable behaviours, such as biting penmates, and providing enough independent space improves behaviour in piglets in a barren environment.

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