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Effect of straw enriched environment on behaviors of nursery piglets reared in the farrowing pens

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Abstract

The aim of the present study was to study the effects of straw enriched environment on behaviors of nursery piglets reared in the farrowing pens. Fourteen litters (Large White × Landrace) weaned at 35 days of age were reared in the modified farrowing pens, flatdecks (F) or straw enriched pens (P), until 70 days of age. The behavior was observed from 7 to 10 weeks of age. Results showed that straw enriched pens significantly increased walking, total exploring and active behavior, reduced lying and exploring behavior direct to pen, but not that direct to penmates. Meanwhile, in wk8-wk10, the number of fighting piglets in P was significantly more than that in F. With increasing age, piglets exploring in total or direct to pen, and active piglets decreased gradually in F. In P, piglets exploring in total or that direct to straw decreased, and reached a trough in wk9, then rose up. Lying piglets in F increased with age while that in P increased only at 9 or 10 weeks of age. Walking piglets decreased significantly with age in both environments. The number of fighting piglets in F was a maximum in wk7 while it in P was fewer in wk7 or wk8. Furthermore, the activity of piglets in F was at peak during 08:00-10:00 hr and reached a trough during 11:00-13:00 hr. In P, refreshed straw kept piglets at a more active state during morning, shortened the activities trough at noon, and showed high activity in the afternoon. In conclusion, present straw enriched pen can prevent fighting, increase total exploring, reduce exploring direct to pen, and even affect the rhythm of behavior. It is applicable for improving welfare of nursery piglets.

Key words

Behavior, Nursery pen, Piglets, Straw

Introduction

Weaning is a critical period for piglets. After weaning, piglets need to adjust their feeding and drinking behavior quickly (Oostindjer *et al.*, 2011). However, it is usually difficult to do so, and feed intake will not recover to the level before weaning until the second week after weaning (Brooks and Tsourgiannis, 2003). Growth of piglets reduces transiently after weaning, because there are many stressors, such as an abrupt separation from the sow, a different food source, transportation and handling, and so on (Jarvis *et al.*, 2008; Campbell *et al.*, 2013). Moving piglets to a new environment as well as mixing them with unfamiliar conspecifics at weaning have stressful effects which are additive (Colson *et al.*, 2012). It has been reported that weaning stress can cause transient increase in cortisol (Carroll *et al.*, 1998; Colson *et al.*, 2012), and 5 days after weaning, cortisol concentration drops to pre-weaning level (Hay *et al.*, 2001).

Different rearing environments have extremely important impact on weaners' stress and behavioral development. Piglets' strong motivation to explore is significantly helpful for behavioral development, and can enhance their capacity to respond to the environment. But usually no suitable enrichment material is used in nursery. Straw is commonly used as environmental enrichment objects, because it can stimulate feeding and exploring behaviors, which meets the needs of piglet behavior (Tuyttens, 2005), and straw can be manipulated easily (Van de Weerd *et al.*, 2006). Weaned piglets reared in straw-bedded pen were more

active (Fraser *et al.*, 1991), performed more rooting, chewing and other straw directed behaviors, and even more playing (Pearce and Paterson, 1993; Kelly *et al.*, 2000; Bolhuis *et al.*, 2005), which resulted in fewer potentially injurious behavior on themselves or penmates (Kelly *et al.*, 2000), and relieved stress in barren environment.

Current researches on the welfare of weaned piglets are mostly focused on weaning stress, abnormal sucking, and fighting after mixing. The present study aimed to study the effect of straw enriched environment on behavior of 5 weeks old nursery piglets reared in the modified farrowing pens which avoided changing pen and mixing.

Materials and Methods

Animal and housing : This experiment was conducted in livestock farm of Northeast Agricultural University (Harbin, China).There were two types of experimental pens, farrowing-nursery stall (1800mm×2150mm) and straw enriched farrowing-nursing pen (2100mm×5700mm), located in one house with natural light and ventilation. Fourteen litters (Large White × Landrace) were weaned at 35 days of age (sows and weaker were removed), and reared in their farrowing pens until 70 days of age. During experiment, the temperature was kept between 19°C and 25°C and the mean relative humidity during the experiment period was 73.5%.

Seven litters (61 piglets) were housed in flatdecks (F) which were modified from the farrowing crate, with sow stall and piglet box removed. Seven litters (63 piglets) were housed in straw enriched pens (S) which were modified from the farrowing pen with piglets creep and guard rail removed.

During experiment, water was continuously available and piglets had *ad libitum* access to feeds (A: extruded pellets, from 28 to 49 days of age; transit to B gradually from 50 to 55 days of age; B: mesh, from 56 to 70 days of age). The pens were cleaned daily at 05.30 and 15.30 hrs. Health inspection and disease treatment were performed at 06.00 hrs, and following that approximately two kilograms of unchopped paddy straw was added to the resting area (2100mm×2100mm) of the straw enriched pens every day at 06.30 hrs.

Behavioral observations : The official 4-week experiment began after 1 week of pre-experimentation (the first week after weaning). The piglets were videotaped continuously from 07.00 to 15.00 hrs on 3rd and 6th day of each week, and observed using the Observer XT system (Noldus Information Technology, Wageningen, the Netherlands) with a 5-min instantaneous scan. Each hour was set as an observation period (H7, H8, H9, …, H14), so there were 12 observations per observation period for a litter. The behavioral response as studied by posture and activity are defined in Table 1.

Statistical analysis : The ratio of piglets, in the litter that performed a specific behavior, was calculated as frequency of behavior of the sampling points. Only total lying was analyzed, as lateral or ventral lying did not significantly differ between the treatments.

IBM SPSS statistics 20 was used for analyses of the experimental data. One-Sample K-S Test was used for normal test. Variables not normally distributed were log transformed. Multivariate analyses were conducted for some behaviors in which there were interactions between treatments and other factors. Regression analyses were performed using curve estimation if an interaction was observed. All the results of the statistical analysis were presented as mean ± SE.

Results and Discussion

Each week, fewer piglets were lying in P than in F, though it was insignificant ($p>0.10$) in wk7; each week, significantly ($p<0.01$) more piglets performed walking, exploring, and active behavior, and significantly ($p<0.01$) fewer piglets feeding in P than

Table 1 : Behavioural categories and their defintions in nursery piglets observed during experimental period

Behavioural categories		Definitions
Posture		
Standing		Assuming or maintaining an upright position on extended legs (includes kneeling and walking).
Lying	Ventral lying	Lying down with chest and abdomen making contact with the floor and front legs stretched or folded under the body.
	Lateral lying	Lying down with one shoulder making contact with the floor.
Activity		
Walking		Pig is up on all four legs and moving at time of sample.
Fighting		Biting, ramming, pushing, lifting, or chasing penmates.
Feeding		Head is down in feeder.
Exploring	Direct to pen	Licking, biting, pawing or nosing pen components (includes floor, trough, bars and walls).
	Direct to straw	Nosing, rooting, pawing, biting, chewing, or holding straw.
	Direct to pigmates	Oral or nasal contact with penmates.
Active		All of the active behaviors above.

Table 2 : Rates of piglets performing specific behavior in different developmental stages (%)

Behavior	Treatment	wk7	wk8	wk9	wk10
Lying	F	65.52^{xc}±0.96	71.96^{xb}±0.78	74.38^{xa}±0.75	76.13^{xa}±0.73
	P	64.27^{xb}±0.98	61.03^{yc}±0.82	67.25^{ya}±0.87	67.55^{ya}±0.85
Walking	F	2.07^{ya}±0.17	0.95^{yb}±0.10	1.02^{yb}±0.12	0.41^{yc}±0.07
	P	8.93^{xa}±0.42	7.73^{xb}±0.32	5.52^{xc}±0.28	4.97^{xd}±0.30
Fighting	F	2.01^{xa}±0.20	1.19^{yb}±0.14	0.82^{yb}±0.11	1.02^{yb}±0.13
	P	1.76^{xb}±0.17	1.93^{xb}±0.14	2.83^{xa}±0.19	2.44^{xa}±0.19
Feeding	F	14.69^{xb}±0.60	15.01^{yb}±0.56	17.58^{xa}±0.61	16.28^{xb}±0.59
	P	13.90^{yc}±0.72	18.72^{xa}±0.71	17.53^{xb}±0.76	14.90^{yc}±0.72
Active	F	38.56^{ya}±0.97	34.53^{yb}±0.83	33.93^{yb}±0.86	33.11^{yb}±0.83
	P	45.78^{xab}±1.03	48.06^{xa}±0.89	43.27^{xb}±0.97	46.44^{xab}±0.97
Exploring	F	17.14^{ya}±0.57	14.31^{yb}±0.46	11.40^{yc}±0.40	12.22^{yc}±0.42
	P	24.21^{xa}±0.69	20.95^{xb}±0.55	17.83^{xc}±0.57	24.18^{xa}±0.68

$^{x, y}$ Values of different treatments not sharing a common superscripted letter are significantly different from each other ($p<0.01$); $^{a, b, c, d}$ Values in the same row not sharing a common superscripted letter are significantly different from each other ($p<0.01$)

that in F (Table 2). Each week, the number of exploring piglets direct to pen in F was significantly more ($p<0.01$) than that in P, but there was no significant difference in the number of exploring piglets direct to penmates between the environments (Fig. 1). Thus, in the present study, adding straw daily met the nursery piglets' requirement for rich environment, and led to significantly less exploring direct to pen. Oostindjer *et al.* (2011) observed that enriched housed piglets showed higher levels of exploring, but lower levels of belly nosing and manipulative behaviors than piglets in barren postweaning pens. Hunter *et al.* (2001) found that providing straw everyday efficiently reduced the risk of tail biting. The reason for the number of exploring piglets direct to penmates close to each other between the environments may be mainly that nursery pigs were reared in their farrowing pen which prevented the influence of mixing and the change of pens. So no serious tail or ear biting but mild nibbling or body rooting were found in both environments during nursery periods, and there was no significant change with the development in behavior direct to penmates (Fig. 1). Nursery piglets in both the environments spent a lot of time rooting and biting (direct to pen, penmates, or straw), which was in line with the results of Bolhuis *et al.* (2005).

Bolhuis *et al.* (2005) reported that oral exploring increased with age. However, in the present study, the number of piglets exploring in total or those exploring direct to pen significantly decreased ($p<0.01$) from wk7 to wk9 in F (Table 2 and Fig. 1), and active piglets were also significantly more ($p<0.01$) in wk7 than that of wk8, wk9 or wk10 (Table 2); the total number of piglets exploring or those exploring direct to straw in P also decreased ($p<0.01$) gradually with age, and reached the lowest point in wk9, then with significantly ($p<0.01$) rising up of exploring direct to straw in wk10, total exploring and active behavior both significantly ($p<0.01$) increased (Fig. 1). The significantly rising up of straw exploring in wk10 may be caused due to inadequate straw supply, which became a resource of nursery pigs to fight for. Schaefer *et al.* (1990) also observed that there was more fighting when enrichments were limited.

The differences observed in studies may also be due to different pen sizes. Beattie *et al.* (1996) stated that in small or strawless environment there were less exploring and active behavior, and more injurious behavior (such as belly booting, tail biting, etc.), furthermore, the more spacious in the enriched environment, the more walking of the pigs. In present experiment, although walking piglets decreased significantly ($p<0.01$) with the increase of weeks of age in both environments, the walking of piglets in straw enriched pen kept at a higher level (Table 2), which may also be the result of space.

Space can also have effect on lying and fighting behavior. In wk7, there was no significant difference in lying or fighting between nursery piglets in different environments (Table 2), and the behavioral differences were mainly caused due to attraction of straw to nursery piglets, which aroused more exploring direct to straw and less exploring direct to pen, and made them more active. Further, lying piglets in F increased ($p<0.01$) with age while that in P increased ($p<0.01$) only at 9 or 10 weeks of age (Table 2). Thus, there were more piglets lying in F than in P. The number of fighting piglets in F was maximum in wk7 while in P was significantly ($p<0.01$) fewer in wk7 or wk8 than in wk9 or wk10 (Table 2). Fighting piglets in F were significantly ($p<0.01$) fewer than that in P from wk8 to wk10. In the present study, piglets in straw enriched pen were more active and aggressive when manipulating straw; pen space might be an important influential factor on that, or it's only caused by stimulus of straw. Chaloupková *et al.* (2007) suggested that pre-weaning straw environment and enlarged space substantially reduced the tendency of aggression in later life during food competition.

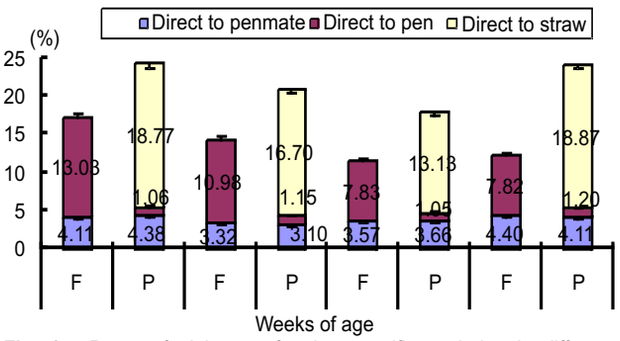
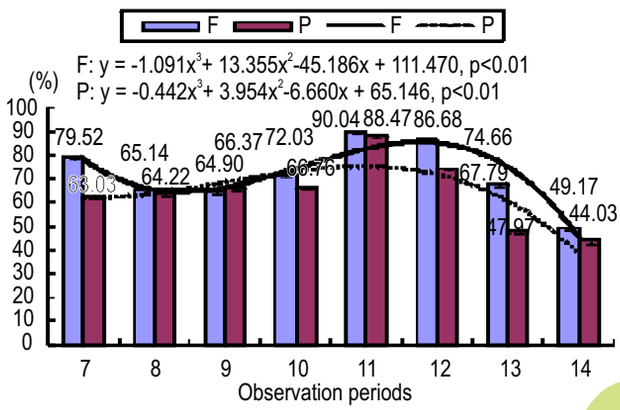
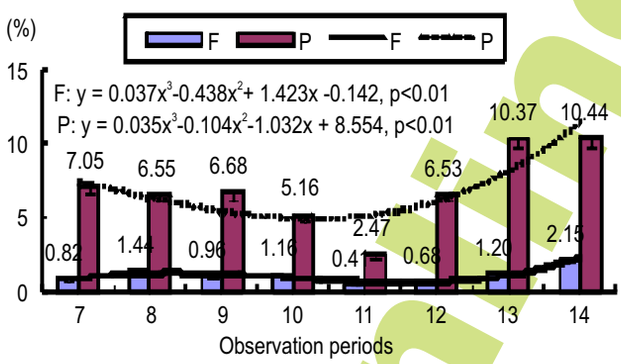


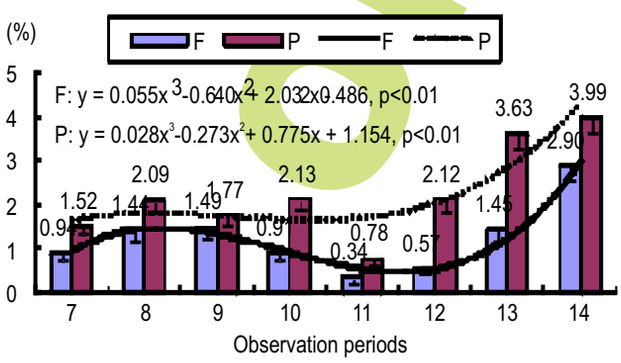
Fig. 1 : Rates of piglets performing specific exploring in different developmental stages



A: Rates of piglets performing lying in different observation periods

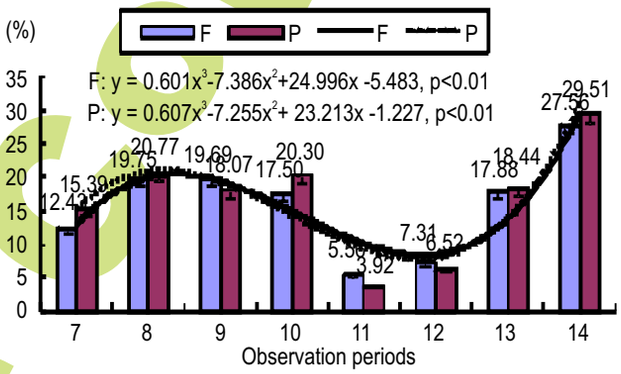


B: Rates of piglets performing walking in different observation periods

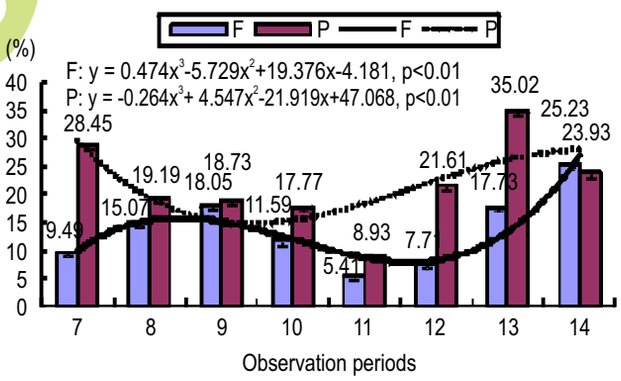


C: Rates of piglets performing fighting in different observation periods

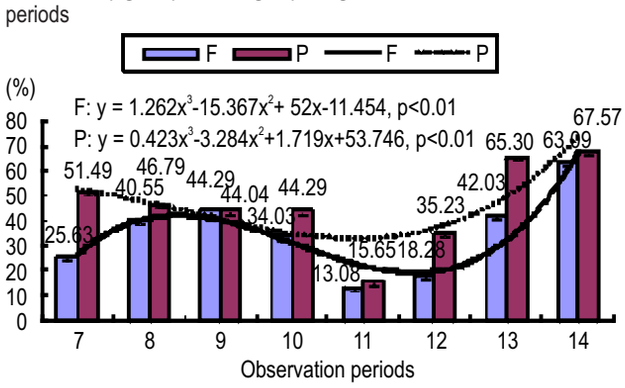
Studies of Beattie *et al.* (1996) and Bolhuis *et al.* (2005) showed that the time of feeding behavior wasn't influenced by environment. However, the results of present experiment showed that, in wk8, nursery piglets in P performed significantly ($p<0.01$) more feeding than that in flatdesks, and also more than that in other weeks of age in the same environment (Table 2). The increased feeding behavior may be due to their hardly adapting to the new powder feed in wk8, which resulted in piglets' less willing to intake due to poor palatability and digestibility. It corresponded to the significantly ($p<0.05$) fewer feed intake in P than that in F from 50 days of age in our associative study (Yin *et al*., 2013).



D: Rates of piglets performing feeding in different observation periods



E: Rates of piglets performing exploring in total in different observation periods



F: Rates of active piglets in different observation periods

Fig. 2 : Rates of piglets performing specific behavior in different observation periods

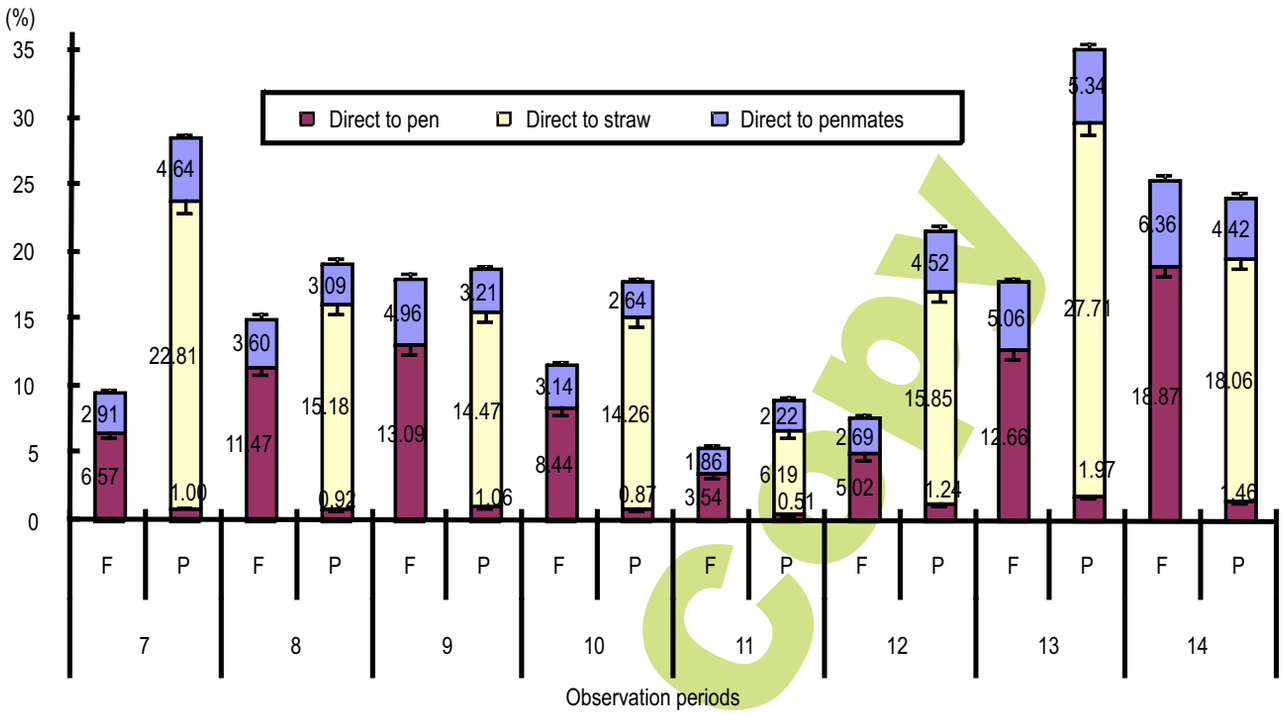


Fig. 3 : Rates of piglets performing specific exploring in different observation periods

Result of the present study also showed that observation periods had significant effect ($p<0.01$) on any observed behavior of piglets in both environments, and each pair of behavior rhythms except feeding varied between the environments (Fig. 2).

In F, piglets preformed more lying, and less walking, fighting, exploring and active behavior in H7, after then, they became gradually active, with less lying (Fig. 2). The activity of piglets in F reached a peak in H8 and H9, and reached trough in H11 and H12, when over 80% piglets were lying still, and then it began another active period from H13 till the end of the observation. The piglets in P were active during entire observation time except for trough in H11 (Fig. 2). Thus, only in H7 or H11, there was significantly difference ($p<0.01$) in feeding between the two environments; in H9, there was no significant ($p>0.10$) difference was observed in lying, exploring or active behavior between nursery piglets in different environments (Fig. 2).

In H7 or H12, there were significantly more ($p<0.01$) piglets exploring direct to penmates in P, while H9 or H14, there were significantly more ($p<0.01$) piglets exploring direct to penmates in F (Fig. 3). It was in line with the rhythm of active behavior in F. Observation periods had significant ($p<0.01$) effect on exploring direct to penmates or pen in each environment (Fig. 3), as a result of the rhythms of active behavior.

The influencing factor on the rhythm activity of nursery pigs was mainly due to refreshed straw in the morning which met their exploring motive, kept them relatively in active state in the morning, shortened the activities trough at noon, and led to a higher active level in the afternoon than piglets in F. Moinard *et al.* (2003) also stated that replacing straw daily (even in a little amount) could bring fresh stimulus.

Certainly, difference in behaviors between nursery environments may also be influenced by previous suckling environment. Beattie *et al.* (1995) showed that providing straw at an early stage of life influenced the behavior and adaptation of pigs in later stages. However, some studies showed that the current enrichment supplement had a greater influence on behavior mode than previous experience in the farrowing pen (Bolhuis *et al*., 2006; Vanheukelom *et al.*, 2011).

Present straw enriched pen was modified from the farrowing pen, which could prevent fighting in mixing, meet the requirement of nursery pigs on enrichments, reduce exploring direct to pen, and increase total exploring and active behavior (especially in the morning). It is applicable for improving welfare of weaned piglets. However, it did not reduce exploring direct to piglets, although no harmful behavior was observed occurred.

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