

Research Article

Effect of Environment on the Productivity and Physiological Indicator of Nursery Piglets

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Abstract: The aims of the present study were to determine the effect of rearing environment on the productivity and physiological indicator during the nursery phase of pigs. 14 litters of commercial crossbred pigs (Large White×Landrace) Weaned at 35 days of age were reared in their original pen with the weaker eliminated. 7 flatdecks (F) and 7 straw enriched pens (S) were modified from the farrowing pen. Feed Intake (FI), Average Daily Weight Gain (ADWG) and Feed Conversion Ratio (FCR) was collected and 2 male and 2 female per litter were randomly selected to measure cortisol, Growth Hormone (GH) and IgG at the end of the experimental period (70 days of age). Results showed that, for piglets in S, FI of was significantly lower ($p<0.05$) from 50 days of age and ADWG from 43 to 70 days of age was significantly lower ($p<0.001$), though GH was significantly higher ($p<0.01$). But there was no difference in FCR, cortisol and IgG between environments. In conclusion, piglets in S had a higher GH, but poor productivity because of unsuitable feed changing and nursery environment had no effect on cortisol and IgG.

Keywords: Nursery pen, physiological indicator, piglet, productivity, straw

INTRODUCTION

Deep-straw system could improve the health and productivity of pigs (Kelly *et al.*, 2000). Numerous studies show that growing/finishing pigs in the enriched environment had higher Feed Intake (FI) and Average Daily Weight Gain (ADWG) than in barren pen (Lyons *et al.*, 1995; Morgan *et al.*, 1998; Van de Weerd *et al.*, 2006; Bolhuis *et al.*, 2006). But Bolhuis *et al.* (2006) found no effect of straw bedding on Feed Conversion Ratio (FCR) of finishing pigs, though pigs in straw system grew faster. For weaned piglets, the results of Bolhuis *et al.* (2006) and Wang *et al.* (2004) showed that straw bedding had no effect on FI, FCR.

Environments also have effect on physiology. The barren nursery pen leading higher cortisol (Pearce and Paterson, 1993), which means a stress state. Stress might inhibit the immune system (De Groot *et al.*, 2000; Brown-Borg *et al.*, 1993; Klemcke *et al.*, 1990). The effects of housing on immune function show a large variation both within and between studies and the impact of environmental factors on immune responses can be influenced by characteristics of the individuals under study (Bolhuis *et al.*, 2003). Bolhuis *et al.* (2003) found, for low-resisting pigs, the humoral immune

responses in barren-house was higher than in enriched house, which seem to contradict this supposed immunosuppressive effect of long-term stress. Sustained stress, rather than suppressing the immune system as a whole, may induce a shift in the balance between the cellular (Th1-mediated) versus humoral (Th2-mediated) immune responses to an antigenic challenge by favoring cytokine patterns that enhance antibody production. And, cortisol is important determinants of the ultimate balance between Th1 and Th2 cytokines (Bolhuis *et al.*, 2003).

The present study investigated the effect of rearing environment on the productivity and physiological indicator during the nursery phase of pigs. For that purpose, weaned piglets from either a straw enriched pen or a farrowing crate were reared in their original pen to avoid the stress of change in social groups or environment.

MATERIALS AND METHODS

Animal and housing: Fourteen litters of commercial crossbred pigs (Large White × Landrace) were used. Weaned at 35 days of age, piglets were reared in their original pen until 70 days of age by removing the sows and the weaker piglets.

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Experimental pens are located in one house with natural light and ventilation. The temperature was between 19 and 25°C and the mean relative humidity was 73.5% in the experiment period.

Seven litters (61 piglets, average weight: 8.29±0.14 Kg) were housed in flatdecks (F) which were modified from the farrowing crate (1800×2150, 300 mm above the ground) with sow stall and piglet box removed. Seven litters (63 piglets, average weight: 8.13±0.14 Kg) were housed in straw enriched pens (S) which were modified from the farrowing pen (2100×5700 mm) with piglets creep and guard rail removed.

During the experiment, water was continuously available from a drinking nipple and pigs had ad libitum access to normal commercial feeds (A: extruded pellets, 13.91 MJ NEv/kg, 20% CP and 1.2% Lysine from 28 to 49 days of age; transit to B gradually from 50 to 55 days of age; B: powder, 13.72 MJ NEv, 17.0% CP and 1.12% Lysine from 56 to 70 days of age).

The pens were cleaned at 0530 and 1530. Health inspection and disease treatment were performed at 0600. Approximately two kilograms of unchopped straw was added to the resting area of the enriched pen per day at 0630, following health inspection.

Data collection:

- **Productivity:** Weighting on an empty stomach (between 0600 and 0700) was taken at weaning day, 42 days of age and 70 days of age. The residual feed was weighed at 0600 and the amount of feed provided was recorded daily. FI, ADWG and FCR were calculated.
- **Physiological indicator:** At the end of the experimental period blood samples were collected through precaval vein on four pigs (two males and two females) in each pen before weighing. Plasma

Table 1: Effect of environment on ADWG of nursery piglets

	36-42 days of age	43-70 weeks of age
F	0.284±0.016 ^x	0.638±0.014 ^x
S	0.252±0.011 ^x	0.541±0.013 ^y

Means with different superscripts are significantly different (capital letters means p<0.01 and lowercase letters means p<0.05)

Table 2: Effect of environment on FCR of nursery piglets

	36-42 days of age	43-70 weeks of age
F	1.509±0.183 ^x	1.918±0.036 ^x
S	1.677±0.189 ^x	2.008±0.038 ^x

Data were not statistically significant (p>0.05)

samples were stored at 4°C immediately after collection. After centrifugation (3000 rpm, 10 min.), plasma samples were and stored at -20 °C until assay. ELISA kits (Rapidbio, the United States) were used to measure cortisol (COR), Growth Hormone (GH) IgG.

Statistical analysis: IBM SPSS statistics 20 was used for analyses of the experimental data. The effect of environment was analyzed through One-Way ANOVA. Regression analyses were performed using curve estimation for FI. All the results of the statistical analysis are presented as mean±s.e. value.

RESULTS

FI: As shown in Fig. 1, FI of piglets in S was higher initially, but insignificantly; from 50 days of age, it was significantly lower (p<0.05) than that in F, because FI of pigs in F increased more with the age.

ADWG and FCR: ADWG of pigs in F was higher (p = 0.16) before 42 days of age and significantly higher (p<0.001) from 43 to 70 days of age (Table 1). But there was no difference in FCR over the nursery period (Table 2).

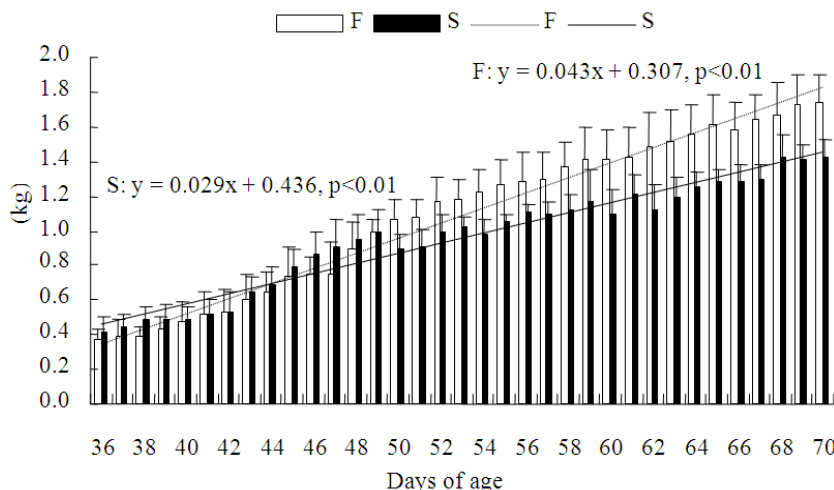


Fig. 1: Effect of environment on FI of nursery piglets

Table 3: Effect of environment on hormone and IgG of nursery piglets

	GH (ng/mL)	COR (ng/mL)	IgG (µg/mL)
F	0.980±0.170 ^Y	167.28±8.76 ^X	49.18±1.39 ^X
S	1.258±0.163 ^X	161.09±10.22 ^X	47.54±1.90 ^X

Means with different superscripts are significantly different (capital letters means $p < 0.01$ and lowercase letters means $p < 0.05$)

Physiological indicator: As shown in Table 2, GH was significantly higher ($p < 0.01$) in S, but there was no significant difference in COR and IgG between the two environments (Table 3).

DISCUSSION

There was no significant difference among FI, ADWG and FCR of piglets from weaning to 6 weeks of age in present study. However, when the feed was changed from 50 days of age, piglets in F had higher FI; along with high ADWG. But, in study of Munsterhjelm *et al.* (2009), both feed intake and weight gain of piglets in straw-bedded pen were higher than that in barren pen, while De Jong *et al.* (1998) and Bolhuis *et al.* (2006) found no improvement of straw enriched environment on productivity of nursery piglets. Toys also didn't affect the productivity of weaning piglets in some research (Pearce and Paterson, 1993; Blackshaw *et al.*, 1997; Trickett *et al.*, 2009).

The difference of productivity in present study may be related to the poor digestive system development of piglets in S caused by their later eating solid feed in suckling stage, then hardly adapting to the new powder feed. Because there was no significant difference in FCR between pigs in the two environments.

Research of Pearce and Paterson (1993) showed that cortisol of weaned piglets in barren pen was higher. However, some studies (De Jong *et al.*, 2000; Rodarte *et al.*, 2004) haven't found difference on cortisol between piglet rearing in enriched and barren pens. There was also no significant effect of environments on cortisol in present experiment, but it couldn't be declared that piglets in F was free of stress. Because the result of behaviour of piglets in F was abnormal in our relevant experiments (unpublished). The low cortisol might be caused by the adaptation of HPA axis under chronic stress and cortisol may return to normal pre-stress (Pignatelli *et al.*, 2000). Furthermore, study by De Jong *et al.* (2000) showed that straw bedding caused increased circadian cortisol levels of young pigs and blunted circadian rhythm of pig in barren pen might result in a lower cortisol concentration in the light period. So more research is needed to elucidate the effects of straw on levels of stress physiological parameters.

GH of piglets in S was significantly higher than that in F, which means a better growth potential. That was in conflict with the results of weight gain. It was

another evidence of which the differences in productivity primarily caused by the feed changing.

It is generally believed that chronic stress could inhabit the immune system (Herbert and Cohen, 1993; Kiecolt-Glaser *et al.*, 1994; De Groot *et al.*, 2000; Brown-Borg *et al.*, 1993; Klemcke *et al.*, 1990), but no significant effect of rearing environment on IgG was found in present study. Research of De Groot *et al.* (2000) who studied immune function of pigs from straw enriched or barren house, also found that there was only slight differences in the investigated parameters of immunity (leukocyte and lymphocyte distributions and in vitro lymphocyte proliferation response to ConA) and concluded that immune system appears to be unaffected by the housing conditions.

Compared with piglets in flatdecks, piglets in straw enriched pen had a higher GH, but poor productivity because of unsuitable feed changing. Therefore, an appropriate feeding program should be designed for pigs in S. Barren environment also had no significant effect on cortisol and IgG, however, further study should be taken to examine whether the piglets are in stress.

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