

Research Article

Separate Effect of a Small Quantity of Straw Provided Daily on Cortisol, GH and Performance of Growing Pigs

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Abstract: In this experiment, 156 piglets (female) at 74-78 days of age were selected from the same environment, and randomly moved to the concrete pen with or without straw (so called Straw pen or Barren pen) after weighed. After a week's pre-experiment, there was an eight-week experiment. Feed intake and weight gain were recorded. Three piglets per litter were randomly selected to measure cortisol and GH before and after the experiment. Results showed that, straw can lower cortisol concentration, but GH, feed intake, weight gain and feed/gain ratio did not significantly differ between treatments. So a small quantity of straw refreshed daily that reduced stress and had no negative impact on performance is an inexpensive way to improve growing pig's welfare.

Keywords: Cortisol, Growing pig, GH, performance, straw

INTRODUCTION

Animal welfare has been a worldwide issue. We should give animal good welfare condition, not only out of ethnic obligation, but to meet the requirements of animal production (Spedding, 2000). Problems in modern pig production are the result of stress syndrome caused by animal's not adapting to its living environment, that is, the result of individual's being a long-term chronic stress state (Jarvis *et al.*, 2002). Therefore, providing welfare environment which meets the biological needs of pigs is the direction of livestock production.

Straw is generally considered to improve the comfort and welfare of pigs (Arey and Brooke, 2006), because straw makes pigs more active (Bolhuis *et al.*, 2005) and spend more time running and circling (Pearce and Paterson, 1993), rooting and chewing straw (Kelly *et al.*, 2000), thus resulting in less potential injuring behavior direct to itself or pen mates. Also, straw leads to a lower cortisol concentration than in barren environment which means less stress, because the high level of free cortisol is also considered an indication of stress state (Wiepkema and Koolhaas, 1993).

In addition, under the influence of HPA axis, growth hormone increase in stress was found in some studies (Rushen *et al.*, 1993), which may affect performance of growth. Extensive literature showed that compare with pigs in the barren pens, feed intake and daily gain of growing pigs in straw enriched pens increase (Lyons *et al.*, 1995; Van de Weerd *et al.*, 2006;

Bolhuis *et al.*, 2006) and with better feed conversion ratio, though Bolhuis *et al.* (2006) found no significant differences. However, no effect on performance was found in most studies (Pearce and Paterson, 1993; Blackshaw *et al.*, 1997; Day *et al.*, 2002) on independent enrichment (chains, ball, iron stick, rubber, banners, etc). Therefore, high productivity brought about by straw enriched pen might be confused by space allocation and respiratory health (Guy *et al.*, 2002a). In most researches, space of straw enriched pen is larger than that in barren environment, for example, it is 3.5 m²/pig vs. 0.76 m²/pig in Beattie *et al.* (1995). And there are also outdoor activity fields outside the enriched pens.

Therefore, the effect of straw as the independent environmental factors on the growing pigs is uncertain. Through ensuring other factors being equal and providing a small quantity of straw daily, present study aims at defining the independent effect of little straw on stress hormone and productivity of growing pigs.

MATERIALS AND METHODS

Animals and care: one hundred and fifty six piglets (female) at 74-78 days of age were selected from the same environment (raised decks), and randomly moved into either a barren pen (B) or a straw enriched pen (S) after weighted. Each treatment contains 6 pens with 13 piglets respectively. There was no significant difference of weight between treatments (B: 42.33±3.86 kg vs. S: 41.92±4.19 kg; p = 0.861).

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Pigs were fed at 05:00, 10:00, 15:00, and 18:00. The pens were cleaned at 07:00 and 16:00. Health inspection and disease treatment were performed at 07:30.

Experimental housing: Barren pen and straw enriched pen are located in a double-column house with natural light. There are ventilating fans on the south wall. The temperature was 20°C-27°C, and the mean relative humidity was 68.7% in experiment period.

The pen has concrete floor and solid wall. There is an aisle in the middle of the house, six pens (5.8 m×2.7 m) on each side. There are interval control groups and experiment groups on each side. The sloped dunging area of the pen had a lowest part near the gate which has a 5 cm space above the floor, and the dung channel is outside the gate. A drinker was placed near the gate. A trough was placed between the dunging area and resting area in order to separate the two places and reduce the pollution of the straw. 1 kg straw was added to the resting area of enriched pen per day at 08:00 after health inspection.

Experimental design: The official trial for eight weeks began after one-week's pre-experiment. The feed intake of every litter was recorded. The weight was taken at the end of the experiment, and analysis was made on the effect of the environmental treatment on the pigs' performance. Three pigs are randomly selected to measure cortisol and GH one day before the experiment and on the ending day, to analyze the effect of the treatment on the pigs' neuroendocrine.

Data collection: Weighting on an empty stomach was taken and feed intake was recorded at 08:00~09:00 am, one day before and after the experiment. Average daily weight gain, daily feed intake and feed/gain ratio were calculated.

Blood sampling through ear venous was taken no more than 5 min to avoid acute stress. The blood was separated after serum separation, and stored in the refrigerator at -20°C.

ELISA kits (Rapidbio, the United States) were used to measure cortisol and GH concentration.

Statistical analysis: SPSS 15.0 was used to make statistical analysis of experimental data. The effect of environmental treatment on the cortisol and GH concentration of growing pigs was analyzed through One-Way ANOVA. The effect on daily weight gain, daily feed intake and feed/gain ratio was analyzed through multivariate.

All the results of statistical analysis were showed by MEAN±SE.

RESULTS

GH is higher in S, but insignificantly; cortisol was significantly higher in B (Table 1).

Table 1: Effect of environment on hormone of growing pigs

Treatment	Cortisol (ng/mL)	GH (ng/mL)
B	250.76 ^x ±6.09	0.975 ^x ±0.016
S	205.51 ^y ±4.55	1.022 ^x ±0.114

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 performance of growing pigs

Treatment	Feed intake (kg)	Daily weight gain (kg)	Feed/gain ratio
B	2.546 ^x ±0.054	0.820 ^x ±0.027	3.114 ^x ±0.128
S	2.520 ^x ±0.058	0.804 ^x ±0.023	3.160 ^x ±0.217

Means with different superscripts are significantly different (p = 0.05)

There was no significant difference among the feed intake, daily weight gain and feed/gain ratio of growing pigs in the two environments (Table 2).

DISCUSSION

In this experiment, cortisol of growing pigs in B was higher than that in S, which shows that pigs in B was under the chronic stress state, because high cortisol is usually considered the features of chronic stress (Wiepkema and Koolhaas, 1993; De Jonge *et al.*, 1996). This result was in accordance with the behavior results in our related experiments (unpublished), in which growing pigs in S can express their exploring behavior.

However, some studies showed that the basic value of cortisol of pigs over 15 weeks of age in enriched pens was higher than that in barren pen (De Jong *et al.*, 1998, 2000; Klont *et al.*, 2001) had the similar result. The opposite results may because pigs in enrichment pen were more active under the stimulation of straw when being tested in those experiments, while present experiment measured the cortisol without environmental stimulus, which get rid of the instant effect of enrichment.

There was no significant difference between the GH of growing pigs in B and S, which is in consistent with the performance in different environments. There was no significant difference among the feed intake, daily weight gain and feed/gain ratio of growing pigs in the two environments. The similar result of Wang *et al.* (2004) showed that adding long straw every day has no significant effect on daily gain and feed/gain ratio of weaning piglets in the partly slatted pen. Study of Guy *et al.* (2002b) also showed that straw had no effect on the feeding behavior of the finishing pigs.

However, Lyons *et al.* (1995) reported that continuous stress of the barren pen without straw led to the decrease of the food intake and weight gain of the pigs. Bolhuis *et al.* (2006) also found that the feed/gain ratio of the pigs in straw enriched pen improved, and studies of Xi *et al.* (2007) also showed that providing other enrichments can increase the weight gain of growing-finishing pigs and has a positive effect on feed-weight gain.

The entirely opposite results in these studies maybe caused by the differences in space, because the straw

enriched pen is usually larger in their studies (e.g., 3.5 m²/pig in Beattie *et al.* (2000) and pigs moved more in a larger space of enriched environment. It seems that the performance of growing pigs not improved in an enriched environment is due to the restriction of space.

Xi *et al.* (2007) studied the effect of other enrichments in the same pen and found no significant effect on food intake, and that single enrichment had no effect on daily weight gain and feed/gain ratio. In the pen (1.2m²/pig) of present experiment, although straw made the growing pigs more active, moving did not increase substantially (unpublished). Therefore, it is of great necessity to provide enough space for pigs in enriched pens. However, result of Beattie *et al.* (1996). found that the performance decreased when area for each pig is larger than 1.1m²/pig. So it needs further study to determine the appropriate space of enriched pen.

And, Bolhuis *et al.* (2006) also found that rearing environment and diverging coping styles had great effect on the performance promoted by enriched environment. Therefore, it also needs to further define the independent effect of straw on the performance of pigs.

CONCLUSION

Without changing other conditions of common commercial house, adding a small quantity of straw daily as enrichment can reduce cortisol and stress of growing pigs. It is a low-cost and feasible way to improve pig welfare, although its promoting effect on productivity is uncertain.

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