

Small Quantities of Straw Provided Daily Improve Behavior of Growing Gilts

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ABSTRACT

Straw can improve the welfare of pigs, but the influences of straw are not easily isolated from the effects of other resources. This study aims at determining the separate effects of straw on the behavior of growing pigs. 156 piglets (female) at 74–78 days of age were randomly assigned to a barren (B) or straw-enriched (S) pen, and the behavior was observed 8 weeks. Results showed that, significantly more pigs were found to be active, lying ventrally, standing, and exploring (total) in S, while there were significantly more pigs lying laterally and directly exploring the pens or pen-mates in B. Furthermore, more pigs in S were observed sitting and walking during the morning observation period. In B, more pigs were lying laterally and fewer were lying ventrally, standing, sitting, walking, exploring, or found to be active throughout the morning observation period. However, the pigs in S were just the opposite. In the afternoon observation period, the number of pigs that exploring direct to straw in S was decreased, with the

number of pigs exploring direct to pen or pen-mates being greater in both environments. As the experiment progressed, the number of pigs lying ventrally or walking decreased notably in both environments. In B, pigs that exploring direct to pen or pen-mates increased initially and then decreased. However, in S, pigs showed a similar trend in activity and exploring direct to straw. In conclusion, only refresh small amounts of straw each morning can have a lasting effect on the exploring behavior of growing pigs and may reduce injurious behavior.

INTRODUCTION

Animal welfare has captured worldwide attention. Problems in modern pig production have been attributed to the stress syndrome caused by the inability of an animal to adapt to its living environment. Essentially, problems arise as a result of individuals being in a chronic state of stress (Jarvis *et al.*, 2002). Therefore, improving environmental conditions to meet the biological needs of pigs and to improve their welfare is essential to the development of livestock production practices.

It is generally believed that straw can improve the welfare of pigs (Arey, 1993), by providing an outlet for exploratory and manipulative oral behavior, such as rooting and chewing (Fraser *et al.*, 1991). Numerous studies (Fraser *et al.*, 1991; Bolhuis *et al.*, 2005; Kelly *et al.*, 2000; Pearce and Pater-son, 1993) have shown that straw increases activity levels in pigs (e.g., running, circling, rooting, chewing straw, and playing) and, thus, decreases the potential injurious behavior direct to itself or its pen-mates (Kelly *et al.*, 2000). Hirt and Wechsler (1994) found that behavioral diversity was higher in the straw bedded pen. As discussed by Tuytens (2005), it seems difficult to find toys that can “entertain” pigs for the same length of time as straw. Furthermore, straw can be manipulated when lying, which increases its utilization (Van de Weerd *et al.*, 2006).

However, the influences of straw are complex and the effects of straw are not easily isolated from the effects of other resources, such as extra space and housing construction (Tuytens, 2005). Few studies have investigated the effects of straw alone. In a study conducted by Fraser *et al.* (1991) on weaned piglets under constant environmental conditions, straw bedding or small quantities of straw in a rack resulted in less oral behaviors directed to pen-mates.

Small quantities of straw have been

shown to occupy a large proportion of the time in which pigs were considered to be active; however, the quantity of straw available can also influence its effect on behavior (Arey, 1993; Kelly *et al.*, 2000; Day *et al.*, 2002). Straw regularly supplied in small quantities is more attractive to pigs than a deep straw system (Hunter *et al.*, 2001). However, limited amounts of fresh straw could incite aggressive competition over a limited resource (Morgan *et al.*, 1998). Limited straw in a rack did not suffice to completely eliminate the vulva biting of gilts in group housing (Krause *et al.*, 1997).

In this study, commercial pens were slightly modified from existing conditions. The purpose of this study was to investigate the separate effects of straw on the behavior of growing pigs through the provision of small quantities of straw daily (and by controlling other environmental factors) and explored a cheap, efficient method for improving animal welfare.

MATERIALS AND METHODS

Animals and care

A total of 156 piglets (female) at 74–78 days of age were selected from the same environment (raised decks) and randomly moved into a barren (B) or straw-enriched (S) pen. Each environmental condition (B and S) contained six pens with 13 piglets in

each pen. 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

Experimental pens were located in a double-column house with natural lighting and ventilating fans. Throughout the experiment, the temperature and mean humidity were maintained at 20–27°C and 68.7%, respectively.

Figure 1 Schematic drawing of the experimental pen

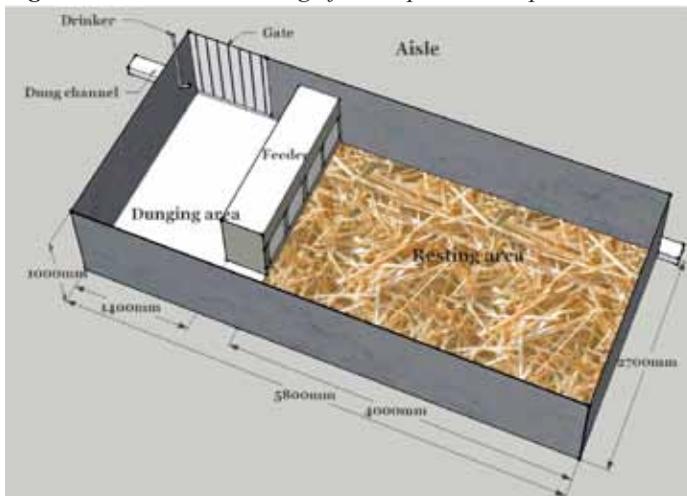


Table 1 Behavioral categories and definitions

Behavioral categories	Definitions
Standing	Maintaining an upright position on all four legs (include moving).
Lying ventrally	Lying down with neither shoulder making contact with the floor.
Lying laterally	Lying down with one shoulder making contact with the floor.
Sitting	Front feet and hind quarters on the floor (>5 s).
Exploring	Direct to pen Licking, rooting, biting, pawing or sniffing pen, feeder or floor.
	Direct to straw Rooting, biting, chewing or holding straw.
	Direct to penmates Licking, rooting, biting, or sniffing penmates.
Walking	Slowly moving and running.
Inactive	Sleeping and lying, sitting, or standing without any Activity.

The pens had concrete floors and solid walls. There was an aisle in the middle of the house with six pens (5.8 m × 2.7 m) on each side. Control and experimental groups were arranged alternatively on each side.

The schematic drawing is showed in Fig. 1. The sloped dunging area of the pen had its lowest part near the gate, which had a 5-cm space above the floor, and the dung channel was outside the gate. A drinker was placed near the gate. A feeder was placed between the dunging area and resting area in order to separate them and reduce the pollution of the straw. One kilogram of straw was renewed in the resting area of the enriched pen per day at 08:00, following health inspection.

Behavioral observations

The official 8-week experiment began after 1 week of pre-experimentation. One experienced observer performed a 6-min instantaneous scan at 08:30–09:30 and 13:30–14:30 on the 1st, 3rd, and 5th day of each week (i.e., a total of 480 observations per pen). The behaviors of interest are listed in Table 1. Active (A) was defined as all behaviors showing an active posture.

Statistical analysis

The ratio of the pigs in the litter that performed a specific behavior was calculated

as the frequency of the behavior of the sampling points. IBM SPSS statistics 20 was used for analyses of the experimental data. The effect of environmental treatment, observation periods, and growing periods was analyzed thoroughly. Multivariate analyses were conducted for some behaviors in which there were interactions between treatment and other factors. Regression analyses were performed using curve estimation if an interaction was observed. All the results of the statistical analysis are presented as mean ± s.e. values.

RESULTS

Time periods

As shown in Table 2, overall, significantly more number of pigs were active ($P < 0.01$), lying ventrally ($P < 0.01$), standing ($P < 0.01$), and exploring (total) ($P < 0.01$) in S, whereas significantly more number of pigs were lying laterally ($P < 0.01$) and exploring direct to pen ($P < 0.01$) or pen-mates ($P < 0.01$) in B. In addition, more number of pigs in S were sitting ($P < 0.01$) and walking ($P < 0.01$) during the morning period.

In both environments, the frequency of behaviors was significantly different between the 2 observation periods ($P < 0.01$). In B, more pigs were active and lying laterally

Table 2 Effect of environment on the behavior of growing gilts during different observation periods

Behavior		Treatment	Morning	Afternoon	Mean
Lying laterally	B		66.80 ^X ±1.99	47.76 ^X ±1.23	57.28 ^X ±1.52
	S		7.02 ^Y ±0.71	26.77 ^Y ±1.14	16.89 ^Y ±1.21
Lying ventrally	B		13.18 ^Y ±0.73	20.13 ^Y ±0.75	16.66 ^Y ±0.63
	S		41.45 ^X ±1.12	36.41 ^X ±0.92	38.93 ^X ±0.77
Standing	B		16.76 ^Y ±1.42	26.02 ^Y ±0.93	21.39 ^Y ±0.97
	S		42.13 ^X ±1.52	30.31 ^X ±1.42	36.22 ^X ±1.20
Sitting	B		3.26 ^Y ±0.31	6.09 ^X ±0.41	4.68 ^Y ±0.29
	S		9.40 ^X ±0.58	6.51 ^X ±0.46	7.95 ^X ±0.40
Walking	B		4.97 ^Y ±0.46	7.52 ^X ±0.48	6.24 ^Y ±0.36
			15.91 ^X ±0.70	9.16 ^X ±0.69	12.53 ^X ±0.60
Exploring	Direct to penmates	B	6.49 ^X ±0.56	9.73 ^X ±0.38	8.11 ^X ±0.38
		S	0.77 ^Y ±0.14	2.69 ^Y ±0.33	1.73 ^Y ±0.20
	Direct to pen	B	11.81 ^X ±1.22	19.37 ^X ±0.93	15.59 ^X ±0.86
		S	1.51 ^Y ±0.19	3.24 ^Y ±0.20	2.38 ^Y ±0.16
	Direct to straw	B	-	-	-
		S	83.87±1.03	51.55±1.23	67.71±1.84
Total	B	18.30 ^Y ±11.09	29.11 ^Y ±6.53	23.71 ^Y ±10.56	
		86.15 ^X ±6.72	57.48 ^X ±8.76	71.81 ^X ±16.37	
Active	B		24.72 ^Y ±1.68	38.60 ^Y ±1.02	31.66 ^Y ±1.21
	S		92.03 ^X ±0.88	67.93 ^X ±1.30	79.98 ^X ±1.46

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

and fewer were lying ventrally, standing, sitting and walking, and exploring in the morning period, while pigs in S showed the opposite behaviors. In the afternoon period, pigs in S that explored direct to straw were fewer, whereas pigs that explored direct to pen or pen-mates were more in both environments.

Developmental stages

As the experiment progressed, the number of pigs in S that were lying ventrally or walking decreased observably; however, the proportion of pigs that explored straw initially increased and then decreased along with total exploration and activity (Fig. 2).

Pigs in B performing lying ventrally or walking decreased observably over the

course of the experiment; however, exploring direct to pen or pen-mates increased initially and then decreased along with the total number of pigs exploring (Fig. 3).

DISCUSSION

Prior studies (Kelly *et al.*, 2000; Bolhuis *et al.*, 2006; Lyons *et al.*, 1995; Beattie *et al.*, 1996; Beattie *et al.*, 2000) have shown that environmental conditions have a significant impact on the behavior of growing pigs. For instance, pigs in barren pens were less active and spent less time exploring, biting of pen-mates was at a fairly high level; however, Arey (1993) concluded that the value of straw for pigs is “occupying”: straw promotes activity; provides an outlet for exploring; and reduces abnormal behaviors, such as biting. Present experiment also showed

that growing pigs in barren pens spent more time exploring the pens and pen-mates; however, they spent less time exploring overall. These data are in accordance with those of a number of previous studies. Studies conducted by Moinard *et al.* (2003) and Scott *et al.* (2007) showed that the exploring of straw decreased behavior directed at pen-mates and the surrounding pens. Studies by Bolhuis *et al.* (2006), Kelly *et al.* (2000), and Pearce and Paterson (1993) also showed that exploring of straw in growing pigs in a straw-enriched pen occupied majority of their active time.

Fraser *et al.* (1991) have stated that, although straw helps to make pigs more active, it has no effect on the amount of time engaged in active behavior. The reason may be that, in their experiment, pigs in barren pens exhibited more biting and abnormal behavior. In the present study, however, exploring by the pigs in the barren pens was mostly directed at the surrounding pen, with minimal behavior directed to pen-mates. The results of current study may be related to environment conditions during early development and population stability.

In the present study, during the 2 observation periods (which did not include the 30-min period immediately following the addition of straw), pigs spent nearly 67% of their time biting straw. Exploring time stimulated by the addition of straw was longer in the present study than in previous studies (the ratio of time spend directly exploring straw to daytime observation range 12–27% (Jensen *et al.*, 1993; De Jong *et al.*, 1998; Scott *et al.*, 2007; Lyons *et al.*, 1995). Therefore, it is more attractive to add small amounts of straw daily, which can effectively promote alternative

Figure 2 Changes in the behavior of the growing gilts in straw-enriched pens with developmental stages

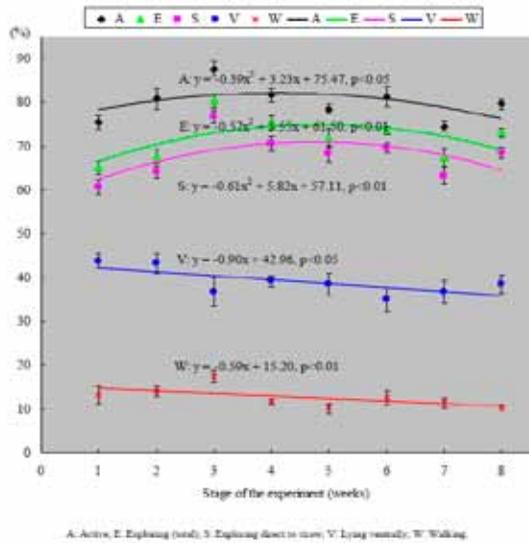
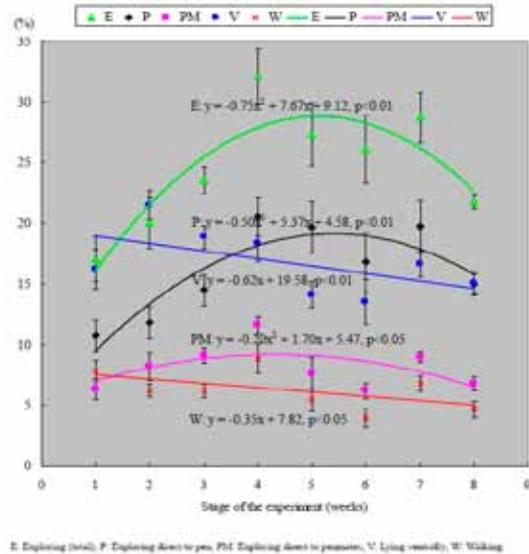


Figure 3 Changes in the behavior of the growing gilts in barren pens with developmental stages



exploring behavior in growing pigs (e.g., exploring straw rather than pen-mates or the pen) and increase overall activity. Certainly, this result may not be entirely applicable to boars because growing gilts show much more exploring behavior than boars (Bolhuis *et al.*, 2006). Furthermore, Morgan *et al.*

(1998) stated that limited amounts of fresh straw might induce aggressive competition for limited resources. Few aggressions and more exploring in current experiment might due to the larger space in present study (1.2 m² per pig).

In the current experiment, more growing pigs in barren pens were observed lying laterally and less were lying ventrally, standing, and walking; this was consistent with the relatively low activity levels observed. In straw enriched pens, lying ventrally, standing, or walking were often accompanied by exploring straw. Other researchers (Guy *et al.*, 2002a, 2002b) have also shown that manipulating straw while lying increased the time for biting straw, which led to engagement in more activities. During the observation period, most growing pigs in straw-enriched pens explored straw while standing or lying ventrally, and nearly half of the exploring occurred when they were lying ventrally. However, Van de Weerd *et al.* (2006) observed that only 6.6% of pigs biting straw were lying ventrally. The discrepancy may be due to the amount of space (1.2 m² per pig in the present study vs. 0.93 m² per pig in Van de Weerd *et al.*, 2006). Furthermore, growing pigs in straw-enriched pens exhibited more sitting in this experiment, most of which was accompanied with exploring straw. In a study by Guy *et al.* (2002b), pigs in straw-bedded pens showed sitting behavior at similar levels as pigs in barren pens, which could also be the result of space allowances.

Comparisons of behaviors during the morning and afternoon observation periods in the present study showed that the growing pigs in the barren pens were more active (i.e., lying ventrally, standing, sitting, walking, and exploring) in the afternoon. Fresh straw added in the morning increased exploring behavior at this time. As the time progressed, however, most of the straw was consumed or stained, and pigs increasingly began to direct their exploring behavior at the pens or pen-mates. Straw still occupied most of the exploring time, however, indi-

cating that small amounts of straw (which is no longer novel) could reduce adverse behaviors. The increased exploring behavior of the pigs that was directed at pens or pen-mates in the barren pens in the afternoon also suggests that providing proper amounts of fresh straw in the afternoon, when growing pigs are active, may be much more important.

The present study found that, as the experiment progressed and animals aged, lying ventrally and walking in both feeding environments decreased; this might be due to the lack of activity space as the pigs matured. However, exploring behavior direct to pen or pen-mates in barren pens did not increase over the course of the experiment, but began to decrease around weeks 4-5 (about 16 weeks of age). The observed decrease could be an indication that the pigs were becoming more indifferent to the barren pen. Pigs in barren pens can keep far away from disagreeable environments through a “cut off” reaction caused by lack of interest (Pearce, 1989). In straw-enriched pens, exploring of pen-mates and pens occurred rarely, and there were no obvious changes over the course of the experiment. Exploring of straw and activity of growing pigs in straw-bedded pens, however, increased initially and then decreased. These results may be an indication that the straw was not as appetitive as it was when first introduced. Although straw exploration decreased in the later stages of the experiment, it was still effective in reducing behavior directed pen-mates and pen. Changes in exploring behavior might also be influenced by space (particularly in straw-enriched pens), and further studies are required to investigate these effects and develop solutions.

CONCLUSION

In conclusion, without the influence of extraneous environmental factors, adding small amounts of straw in the morning on a daily basis can maintain its appeal and stimulate straw exploration, thus increasing the activity levels of growing pigs and reducing behavior directed to pen or pen-mates. How-

ever, the effects of straw can be weakened following consumption and staining, and it should be taken into account when implementing an enrichment program.

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