

Environmental enrichment improves the performance and behavior of piglets in the nursery phase

[*O enriquecimento ambiental melhora o desempenho e comportamento de leitões na fase de creche*]

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ABSTRACT

In modern pig farming, the search for systems that promote environmental quality and welfare is an important issue. In this sense, the present study evaluated the effects of environmental enrichment on the performance and behavior of piglets. In a completely randomized block design, 32 piglets (7.43kg mean weight), weaned at 28 days of age, were distributed into four treatments (control without enrichment, environmental enrichment with wood shavings as bedding; environmental enrichment with hanging toys and environmental enrichment with wood shavings + hanging toys). Four repetitions were performed for each treatment, with two animals per experimental unit. The instant scan sampling technique was used to record the behavior of each piglet for 20h. Animals receiving environmental enrichment with wood shavings + hanging toys were heavier at 70 days ($P=0.02$), exhibited higher total and daily weight gain ($P=0.04$ and $P=0.02$, respectively) and better feed conversion ($P=0.02$). Environmental enrichment increased the interaction of animals with the environment, allowing them to exhibit natural behaviors.

Keywords: animal behavior, animal welfare, feedlots, pigs stress, pigs weaning

RESUMO

Na suinocultura moderna, a busca de sistemas que promovam a qualidade e o bem-estar do meio ambiente é uma questão importante. Nesse sentido, o presente estudo avaliou os efeitos do enriquecimento ambiental sobre o desempenho e o comportamento de leitões. Em um delineamento em blocos ao acaso, 32 leitões (7,43kg de peso médio), desmamados aos 28 dias de idade, foram distribuídos em quatro tratamentos (controle sem enriquecimento, enriquecimento ambiental com cama de maravalha, enriquecimento com móveis e cama + móveis). Quatro repetições foram realizadas para cada tratamento, com dois animais por unidade experimental. A técnica de amostragem de varredura instantânea foi usada para registrar o comportamento de cada leitão, totalizando 20h. Os animais que receberam enriquecimento ambiental com cama + móveis foram mais pesados aos 70 dias ($P = 0,02$), apresentaram maior ganho de peso total e diário ($P = 0,04$ e $P = 0,02$, respectivamente) e melhor conversão alimentar ($P = 0,02$). O enriquecimento ambiental aumentou a interação dos animais com o meio ambiente, o que lhes permite exibir comportamentos típicos.

Palavras-chave: bem-estar animal, comportamento animal, confinamento, desmame de suínos, estresse de suínos

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INTRODUCTION

Animal welfare jointly with environmental and food safety will be one of the major challenges of agriculture in coming years (Rollin, 1995; Hotzel, 2005). According to Cordeiro (2007), production systems designed to improve animal welfare can be a niche market capable of achieving enhanced marketing opportunities and better prices.

In pig farming, welfare conditions should be especially observed at critical stages such as weaning, when piglet performance may be affected by behavioral, physiological, immunological and microbiological changes (Molino and Balbino, 2010). Timely and sufficient nutrient intake during the immediate post-weaning period is crucial for piglets' growth, health, and welfare (Bruininx *et al.*, 2002; Bolhuis *et al.*, 2009). Despite several management strategies applied to encourage piglets to eat, most suckling and newly weaned piglets are still very reluctant to consume solid feed (Edge *et al.*, 2005; Wattanakul *et al.*, 2005; Berkeveld *et al.*, 2007).

According to the European Commission policy (98/93), pig investigated and handled in scientific research must have permanent access to sufficient amount of suitable materials (e.g. straw, hay, wood, sawdust, mushroom compost, peat) that do not compromise their health. The addition of these materials to animal environment consists of environmental enrichment, which principle is to increase the life quality under captivity conditions by identifying and using environmental stimuli necessary to promote animals with psychological and physiological welfare (Shepherdson, 1998; Young, 2003). Providing enrichment after weaning may facilitate the weaning process for piglets by giving distraction and has the potential to reduce the cortisol response to weaning (Beattie *et al.*, 2000; Dudink *et al.*, 2006; Fraser *et al.*, 1991; Moncek *et al.*, 2004).

In modern industrial pig farming, animals have traditionally been housed in concrete pens without any environmental enrichment. However, piglet environment can be enriched with materials that are easily found, such as wood shavings as bedding and hanging toys constructed with wires and chains. This study

evaluated the effects of environmental enrichment on the behavior and performance of weanling pigs and aimed to improve piglets behavior and performance with different types of environmental enrichment. We hypothesized that the improvement in weanling pigs' welfare may influence their performance.

MATERIAL AND METHODS

The experiment was carried out in the Pig Farming Section of the Animal Husbandry and Nutrition Laboratory (LZNA), Center for Agricultural Science and Technology (CCTA) "Darcy Ribeiro" at Universidade Estadual Norte Fluminense, Rio de Janeiro, Brazil. We used 32 commercial line piglets (16 males and 16 females) from the crossing of landrace x large white x Pietran breeds coming from different litters, but born on the same day. Male piglets were castrated at seven days of age, and all piglets were weaned at 28 days, with average weight of 7.43kg. The use of animals was approved by CEUA (Ethics Commission on the use of animals) record 073/09. Animals were housed in 2.10x 2.08x 0.93m concrete pens in a barn (3.5m headroom) covered with asbestos cement roof sheets. Two pigs were housed per pen, which was equipped with a 0.44x 0.15x 0.09 m feeding trough and nipple drinker.

In a randomized block design, the animals were distributed into four treatments with four repetitions. Each pen corresponded to one experimental unit.

The treatments were arranged in a 2x2 factorial scheme combining bedding and hanging toys usage in the pens. The control treatment (C) consisted of a bare concrete floor, and the other treatments received wood shavings as bedding (WS), hanging toys (HT) and wood shavings + hanging toys (WS + HT). The bed was composed of wood shavings with 25cm height changed every 10 days and covered the entire pen floor. The hanging toys consisted of chains hanging from the roof, some with tires tied to the end.

The diets offered to the pigs were formulated according to 95% of their nutritional requirements in the nursery stage, as proposed by Rostagno *et al.* (2011). The animals received water and feed supply *ad libitum* throughout the experiment.

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Piglet behavior was recorded by instant scan sampling, at 1-min intervals for 2h in the morning and 2h in the afternoon for 5 days of the experiment (days 01, 09, 17, 26 and 35), totaling 20 observations per animal. The observations took place in the morning (6a.m. to 12p.m.) and afternoon (12p.m. to 6p.m.). Behavior description was adapted from Pandorfi *et al.* (2006) (Tab. 1).

Feed intake, weight gain and feed conversion were evaluated. To calculate the feed consumption, the amount of feed, leftovers and waste were weighed every day. Feed intake (FI) was taken by difference. To calculate the body weight gain, the animals were weighed at the beginning and the end of the experiment. Body

weight gain (WG) was taken by difference. The feed conversion (FC) was calculated as the ratio of feed intake and weight gain. All performance measurements were made in each pen.

A digital maximum-minimum thermometer kept in an empty pen monitored the environmental temperature. A black globe thermometer was also used.

Normality of data distribution regarding piglet behavior and growth performance was confirmed by the Lilliefors test before being analyzed by the F test (ANOVA), at a significance level of 0.05 and using Saeg 9.1 software (2006). Behavioral data are presented in percentage values.

Table 1. Piglets behavior referring to position, location and observed behavior

Behavior observation	Description
Four support	Standing in the pen.
Lying	Lying in the pen.
Ground	Located on the ground.
Feeder	Located on the feeder.
Walking	Getting around the pen.
Eating	Ingesting food at the feeder.
Digging	Exploring the floor or parts of the installation.
Stationary	With open and immobile eye.
Animal x environment interaction	Playing with enrichment.
Urinating	Urinating.
Defecating	Defecating.
Scratching	Rubbing body parts on the premises
Sleeping	Laying close-eyed in any region of the pen.
Drinking	Ingesting water.
Vocalizing	Producing sounds and grunts.
Biting	Biting part of the premises.

RESULTS

According to Tab. 2, there was no significant effect ($P > 0.05$), compared with the position of the animals, but there was no effect ($P < 0.05$), compared with the position of the animals in the morning shift, where animal treatment without enrichment had the highest time in the feeder (51.6%) and lowest time on the floor (48.4%) compared to treatment with more hanging toys which were 89.5% and 10.5% of time on the floor and trough respectively in the morning shift. Regarding the behavioral activities, the data shows an interaction of the animals with enrichment ($P < 0.05$), especially in the afternoon

and it seems that they preferred to interact with hanging toys compared to wood shavings. Animals without enrichment slept more compared to animals that had only wood shavings or wood shavings with mobiles in the morning shift.

Tab. 3 shows that there was a significant effect ($P < 0.05$), concerning the animal performance between treatment without enrichment and treatment with wood shavings and hanging toys for the final body weight (21kg x 27.05kg), body weight gain (14.5kg x 18.29kg), average daily gain (370.05g x 483.5g) and consequently feed conversion (1.78 x 1.19).

DISCUSSION

Considering the materials used in environmental enrichment, only the association of shavings (as bedding) with hanging toys improved piglet performance (e.g. daily and total body weight gain, and feed conversion) and the exhibition of behaviors that are typical for piglets. This confirms the studies of L. Melotti (2011) that associated substrates as extra enrichment for weaned piglets resulting in aggression decreases, exploratory behavior increasing and faster growing compared with piglets raised without any enrichment.

In all treatments, the animals spent more time sleeping and close to the feeding troughs in the morning (Figure 1). This likely occurred because piglets are sensitive to cold, especially in the morning. The diet in the feeding troughs probably promotes better heat insulation than the floor, and therefore, piglets that were close to it avoided heat loss to the environment (Ashrae, 2001). In pens enriched with both wood shavings and hanging toys, however, piglets remained for a shorter period close to the feeding troughs, resulting in feed waste. As a result, feed conversion and weight gain improved, according to Melotti (2011) who said that using enrichment significantly improved animal performance. This can be explained by the decreasing aggressive behavior decreasing and increasing exploratory behavior of the animals housed in enriched pens. It may have reduced stress related with mix of animals and consequently improved the average growth of these animals. Corroborating these findings, animals from the control group, which did not receive any enrichment in their environment, spent more time sleeping than piglets from the other treatments.

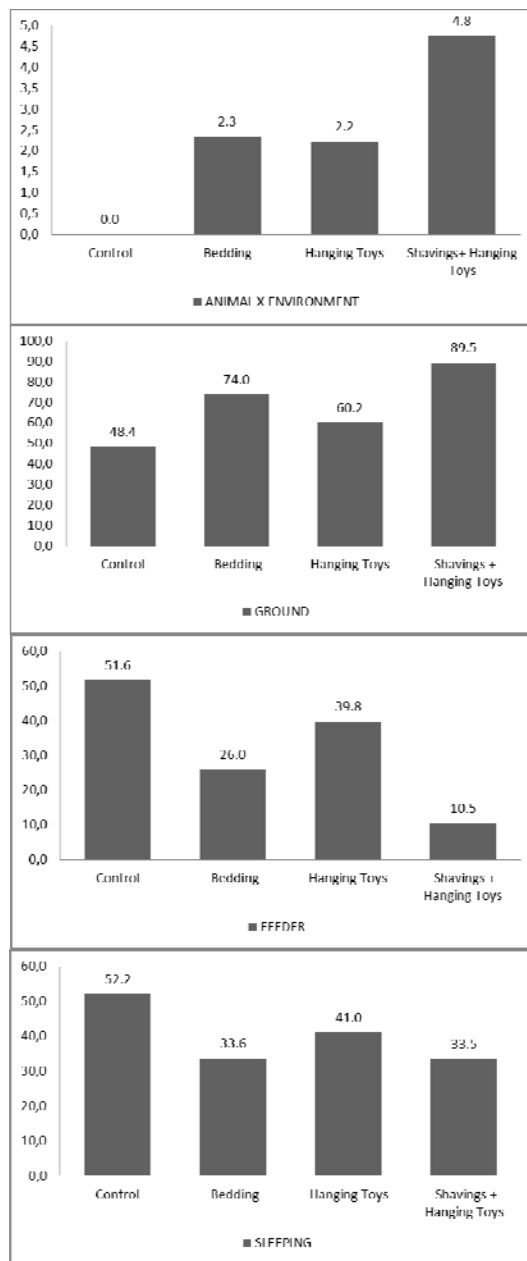


Figure 1. Occurrence (%) of the behaviors observed during the experimental period obtained from piglets in the nursery phase receiving different types of enrichments.

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Table 2. Average percentage of observed behaviors of 32 piglets in the morning, afternoon and full period

	C			WS			HT			WS+HT		
	Morning	Afternoon	Total	Morning ^b	Afternoon	Total	Morning	Afternoon	Total	Morning	Afternoon	Total
Four support	26.9	56.2	41.6	41.0	50.3	45.6	34.6	45.7	40.1	37.7	58.1	47.9
Lying	70.8	41.1	56.0	57.2	46.3	51.8	63.6	51.1	57.3	57.2	35.6	46.4
Ground	48.4 ^b	65.5	57.0	74.0 ^a _b	75.5	74.8	60.2 ^a _b	81.4	70.8	89.5 ^a	83.3	86.4
Feeder	51.6 ^a	34.5	43.0	26.0 ^a _b	24.5	25.2	39.8 ^a _b	18.6	29.2	10.5 ^b	16.7	13.6
Walking	2.05	3.43	2.74	2.81	3.55	3.18	1.83	2.38	2.11	2.77	3.17	2.97
Eating	13.8	14.5	14.1	16.1	15.6	15.9	14.9	8.7	11.8	6.6	11.8	9.2
Digging	12.0	29.1	20.6	20.5	26.3	23.4	12.6	20.2	16.4	19.8	23.9	21.8
Stationary	15.4	21.5	18.4	19.1	22.2	20.6	22.4	29.2	25.8	25.5	30.3	27.9
Animal x environment interaction	-	-	-	2.34	3.29	2.82	2.23	7.96	5.10	4.75	6.63	5.69
Urinating	0.26	0.48	0.37	0.35	0.31	0.32	0.31	0.22	0.26	0.29	0.25	0.26
Defecating	0.26	0.55	0.16	0.08	0.17	0.12	0.55	0.00	0.27	0.18	0.17	0.17
Scratching	0.27	0.22	0.12	0.19	0.17	0.18	0.33	0.23	0.28	0.21	0.29	0.25
Sleeping	52.2 ^a	22.6	37.4 ^a	33.6 ^b	22.0	27.8 ^b	41.0 ^a _b	25.4	33.2 ^a _b	33.5 ^b	16.0	24.7 ^b
Drinking	0.81	0.64	0.72	1.63	1.06	1.34	2.23	1.35	1.79	1.68	1.53	1.60
Vocalizing	0.14	0.08	0.11	0.36	0.39	0.37	0.15	0.22	0.18	0.08	0.45	0.26
Biting	0.15	0.89	0.52	0.12	0.48	0.31	0.41	0.14	0.09	0.55	0.27	0.41

Different letters in the same row differ significantly by the Tukey test at 5% probability

Table 3. Effect of environmental enrichment with wood shaving as bedding (WS) and/or hanging toys (HT) on piglet performance, from 30 to 70 days of age

	Treatments				P values		
	Without shaving as bedding		With shaving as bedding		Shaving as bedding	Hanging toys	Shaving as bedding x hanging toys
	Without hanging toys	With hanging toys	Without hanging toys	With hanging toys			
N° of piglets	8	8	8	8	---	---	---
Initial weight (kg)	7.71±0.45	7.05±0.15	7.38±0.52	7.69±0.34	0.51	0.19	0.98
Final weight (kg)	21.0±2.3 ^a	25.5±1.02	22.9±1.09	27.05±0.80 ^b	0.45	0.09	0.02
Weight gain (kg)	14.5±1.5 ^a	17.29±0.83	15.67±0.74	18.29±0.90 ^b	0.49	0.12	0.04
Average daily gain (g)	370.05±35.15 ^a	461.21±21.76	391.51±29.37	483.5±15.62 ^b	0.66	0.07	0.02
Average daily intake (g)	661.32±62.71	766.48±24.27	642.85±45.16	558.66±75.92	0.81	0.16	0.33
Feed Conversion	1.78±0.06 ^a	1.80±0.10	1.74±0.16	1.19±0.18 ^b	0.85	0.82	0.02

Jensen (2009) reported that the animals might exhibit uncommon behaviors when they cannot behave naturally. Some examples of abnormal

behaviors observed in pig farming are navel sucking, tail biting and monotony (Rollin, 1995).

Rollin (1995) reports also that prolonged sleep may be associated with animal welfare, decreasing energy expenditure and improving performance. Our results, however, show the opposite. In the treatment combining wood

shavings and hanging toys, piglets had better performance with less sleep time.

According to Tuytens (2005), wood shavings or pieces arranged in the pen floor as bedding are beneficial to pigs since they meet behavioral needs and provide thermal comfort. In addition, in organic pig farming, Hegelund and Bonde (2011) found that this substrate improves the health of pig feet and legs, which commonly affect those reared on concrete floors without enrichment. Tuytens (2005) and Hegelund and Bonde (2011), however, warn that bedding must be carefully managed due the risk of developing and transmitting enteric diseases.

Another benefit of using wood shavings as bedding is related to pig thermoregulation (Baêta and Souza, 1997; Cordeiro, 2003). Although piglets need to maintain body temperature, they easily lose heat on the cold concrete floor, compromising their thermal comfort. The use of wood shavings on the floor is efficient in preventing heat loss because, in addition to reducing surface contact between the animal's body and the floor, it exhibits low thermal conductivity and capacity.

Held and Mendl (2001) reported that pigs, especially the youngest, are essentially curious animals, which naturally explore the environment and have interactive behaviors such as muzzle/muzzle contact, rooting, biting and playing. Our results show that piglets exhibited these natural interaction behaviors longer when their pens were supplied with hanging toys alone or hanging toys and wood shavings, corroborating Guy et al. (2013). These results indicate that piglets interact better with hanging objects, such as wires and chains, than with stationary elements.

CONCLUSION

Environmental enrichment with wood shavings (as bedding) and hanging toys improved the growth performance and behavioral aspects of piglets in the nursery period. This management

technique may be an important tool in promoting welfare in pig farming.

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