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CONSTRUCTION MATERIAL INTERFERENCE ON AIR TEMPERATURE AND HUMIDITY INSIDE THE PIGLET CREEP AREA

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ABSTRACT: Piglet development in the farrowing house is a determining factor for the economic success of the farm, being essential to use means to ensure the survival and the satisfactory performance of the piglets in this phase. The objective was to evaluate the thermal comfort of two different creeps for piglets. For this, it was used a farrowing house with four individual pens, two made of wood, and two of polyethylene. Inside each creep and at the geometric center of each room, a data logger was installed to record temperature and humidity. Data were collected in four batches every 30 minutes for three weeks. These variables were analyzed using a repeated measures model. The polyethylene creep was the most suitable with 27.36% and 27.19% of the data within the comfort range, while the wooden creep achieved 13.61% and 23.85%, in the weeks 1 and 2, respectively. Only on the third week the wood creep presented better results, with 42.45%, whereas that of polyethylene attained 16.52% of the data within the comfort range. The creeps building materials had influence on the inner air temperature and humidity, and may affect the animals performance. Generally, the polyethylene creep provides better comfort conditions for piglets.

KEYWORDS: Farrowing, welfare, swine.

INTERFERÊNCIA DO MATERIAL DE CONSTRUÇÃO NA TEMPERATURA E UMIDADE DO AR NO INTERIOR DO ESCAMOTEADOR

RESUMO: O desenvolvimento de leitões na maternidade é um fator determinante para o sucesso econômico de granjas, sendo essencial usar meios para alcançar desempenho satisfatório dos animais nestas fase. O objetivo deste trabalho foi avaliar o conforto de dois diferentes tipos de escamoteadores para leitões. Para isto, foi usado uma instalação de maternidade com baias individuais: duas feitas de madeira e duas de polietileno. Foi instalado um *data logger* dentro de cada escamoteador para registrar a temperatura e umidade do ar. Os dados foram coletdos em 4 lotes de animais por 30 minutos por três semanas. Estas variáveis foram analisadas usando um modelo de medidas repetidas. O escamoteador de polietileno foi o mais adequado com 27,36% e 27,19% dos dados dentro da zona de conforto dos animais, enquanto o escamoteador construído de madeira alcançou 13,61% e 23,85% nas semanas 1 e 2, respectivamente. Somente na terceira semana, o escamotedor de madeira apresentou melhores resultados, com 42,45% enquanto que os de polietileno atingiram 16,52% dos dados dentro da zona de conforto. Os materiais de construção dos escamoteadores tiveram influência na temperatura e umidade do ar e podem afetar o desempenho animal. Em geral, o escamoteador de polietileno forneceu uma melhor condição de conforto para os leitões.

PALAVRAS-CHAVE: Maternidade, bem-estar, suíno.

1 INTRODUCTION

Piglet development during suckling period is a determining factor for the economic success of the pig farming, being essential to use means to ensure the survival and the satisfactory performance of the piglets in this phase.

The newborn piglet has thermoregulatory and immune systems weakly developed, becoming sensitive to low environmental temperatures. Under these conditions, the piglet decreases its activity and consequently it reduces colostrum intake. This leads to higher incidence of diseases, greater number of piglets crushed and high rate of culled piglets (AIRES et al., 2014).

For reducing the occurrence of trampling, it is important to begin using the creeps as fast as possible after piglet birth. However, the creep use depends on how the animal distinguish the attractive area (SABINO et al, 2011). Temperature, location, and access to the area, light conditions (LARSEN; PEDERSEN, 2015), and comfort of the creep area influence its use by the piglet.

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Air temperature is the most influential factor on the animal heat production. The optimum temperature for piglets is age-dependent, start at 30-32ºC at birth and reach 22-24 ºC on the fourth week of life (FERREIRA, 2012).

Temperature effect on animals comfort conditions can be aggravated by air relative humidity. When it is high, above 70%, the heat dissipation through increased respiratory rate is inefficient (FERREIRA, 2012). Respiratory diseases such as rhinitis and allergies represent another problem caused by low humidity, especially below 50%.

There are several ways of heating the creep area, such as heated floors electrical resistance (SOUSA, et al., 2014; SARUBBI et al., 2010).

Another very important factor to achieve a favorable environment to piglets in the creep area is the type of building material used (OLIVEIRA, 2010; DI CAMPOS, 2010).

In Brazil, the majority of creeps are masonry-made, allowing an easy cleaning and high durability, but it is extremely abrasive for piglets and failure in maintaining the air temperature within favorable conditions, especially in the first week of life.

Nevertheless, this situation is changing, since it is already possible to find creeps built with wood or polyethylene, where the internal air temperature remains homogeneous for a longer time with less energy expenditure, but further studies are required (SABINO et al, 2011).

In this way, this study evaluated the thermal comfort of different creeps for piglets during the farrowing period, one built with polyethylene, and another, with wood.

2 MATERIAL AND METHODS

This experiment was developed in the National Center of Research on Swine and Poultry (CNPSA-EMBRAPA) at the Swine Production System. It was used an east-west oriented room, 8.3 m long and 7.76 m width. The farrowing house had four individual and suspended pens. The creeps used are made of wood and polyethylene (Figure 1) distributed in the room according to Figure 2. Each creep contained a 100W incandescent lamp controlled by a thermostat.

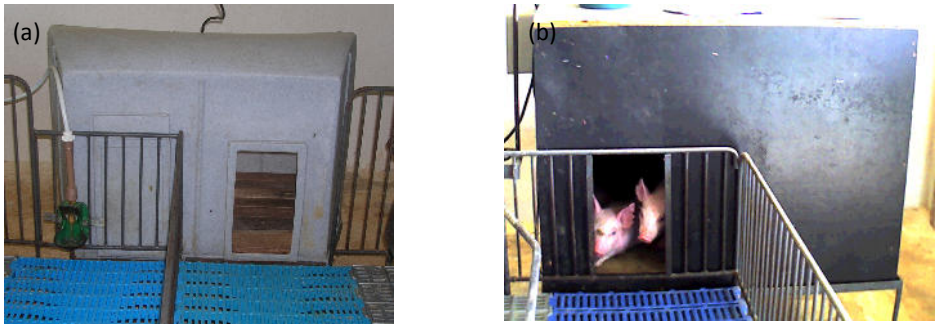

Figure 1 - *Evaluated creeps - (a) Polyethylene creep (width – 0.94 m, height – 0.54 m, length – 0.65 m and lid – 0.94 x 0.34 m) - (b) Wood creep (width – 0.84 m, height – 0.61 m, length – 0.69 m and lid – 0.84 x 0.42 m).*

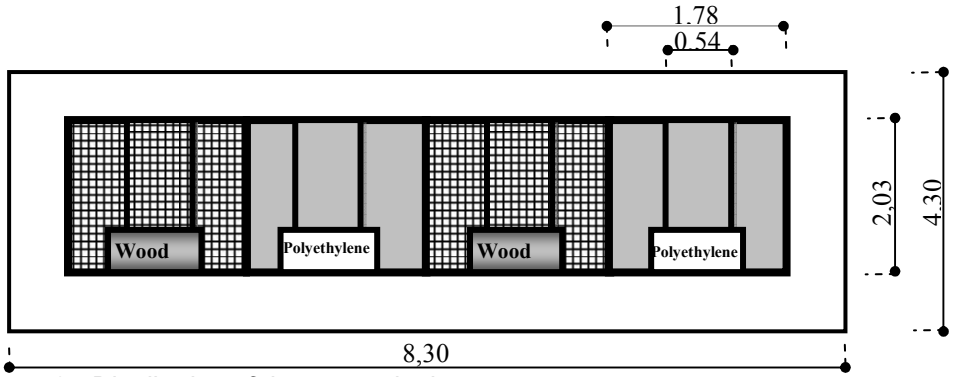

Figure 2 - *Distribution of the creeps in the room.*

Inside each creep and at the geometric center of each room, a datalogger was installed for recording the temperature and humidity every 30 minutes throughout the experimental period. The records were pooled into four batches. For piglets in maternity period, the optimum temperature is age-dependent, as shown in Table 1. Thus, the comfort temperature was considered as 30, 28, and 26^{o}C for the first, second, and third week, respectively, and air humidity ranging from 50 to 70%.

***Table 1** - Minimum and maximum values of temperature and humidity for each week of life.*

Age (week)	Temperature (ºC)		Humidity (%)	
	Minimum	Maximum	Minimum	Maximum
Day of birth	30	32	50	70
1	28	30	50	70
2	26	28	50	70
3	24	26	50	70
4	22	24	50	70

Source: Ferreira (2012)

In addition, we examined air temperature and humidity, amplitude and coefficient of temperature and humidity daily variation (CV) , comfort considering the animals weekly demand for temperature and humidity, and the percentage of temperature below, within, and above the range of thermal comfort.

Initially, it was calculated the means of the variables per week, batch, creep type, and replication. In this way, the data were analyzed using mixed models for repeated measures, considering the effects of batch, creep type, week, and interaction between these last two. The analysis was performed with the SAS´s MIXED procedureand 15 types of variance and covariance matrices were tested. The structure used in the analysis was based on the Akaike's Information Criterion (AIC).

3 RESULTS AND DISCUSSION

A significant effect of the creep type was detected in practically every variable, while the interaction between week and creep type was significant only for comfort temperature and temperature below the comfort.

***Table 2** - Descriptive levels of F-test of the mixed models for repeated measures for each variable analyzed.*

Variable	Source of variation			
	Batch	Creep	Week	Creep ×Week
Temperature[1]	0.2355	0.0014	0.1599	0.2917
Humidity[1]	0.0741	0.0020	0.0942	0.1920
Temperature amplitude[2]	0.0006	0.0093	0.0331	0.9252
Humidity amplitude[3]	0.0024	0.0021	0.5323	0.9624
CV of temperature[5]	0.0002	0.3039	0.0214	0.5719
CV of humidity[3]	0.0006	0.0043	0.3544	0.1331
Comfort[4]	0.0018	0.7875	0.9751	0.1052
Comfort temperature[1]	0.4699	0.6759	0.3608	0.0083
Temperature below the comfort[6]	0.3777	0.0004	<.0001	0.0004
Temperature above the comfort[4]	0.1822	0.0026	0.0003	0.8196

It was used the matrix of variance and covariance of the type: 1st order autoregressive matrix; [2] Toeplitz; [3] 1st order autoregressive heterogeneous matrix; [4] first interdependence; [5] variance components; [6] Huynh-Feldt .

The wood creep had the best air humidity with mean of 69.85 %, while only 58.30% of the data of the polyethylene creep remained within the ideal range, according to Table 1 (Table 3). The humidity is associated with air quality. High relative humidity is not harmful for swine, but frequently indicates that ventilation or air conditioning is not enough. High humidity may negatively affect the housing hygiene and extend the survival of infectious agents on the floor surface and in aerosol. The low humidity may also dry the mucous membrane of the respiratory tract of the piglets, increasing thus the susceptibility to diseases. The wood creep attained the best results of humidity throughout the experimental period, despite that, both creeps had reached around 40% of data out of humidity range considered suitable by Kiefer (2010).

The comfort temperature percentage results indicated that the polyethylene creep presented the highest percentage of data in the weeks 1 and 2 (Table 3). When examined the mean values, the wood creep had the highest value, (26.63%), in relation to polyethylene creep (23.69%). Because on the week 3, the polyethylene creep obtained 42.45% of data within the comfort range, while the wood creep, 16.52%, thus increasing the final mean of the wood creep, not matching the reality throughout the experimental period.

In relation to the temperature below the comfort, the wood creep presented the highest percentage of values during the study period, with a mean of 55.50% while the polyethylene creep obtained a mean value of 14.37%. The contrary was observed for the temperature above the comfort, with a mean of 61.94% for the polyethylene creep, and 17.86% for the wood creep.

Each heating system provides the ideal condition for the animals life given period demanding a special attention from the pig farmer throughout rearing period, especially on the first days of life. Since, at birth, the ability to

retain heat is quite limited and the piglet is almost hairless, devoid of subcutaneous fat, and the heat loss per unit of body weight is inversely related to the body size (HERPIN et al., 2002).

Table 3 - *Percentage of room and creep temperature and humidity values o as a function of the weeks, and descriptive levels of F-test of each creep type.*

Week	Creep type		Pr>F	Room
	Polyethylene	Wood		
		Air Humidity		
1	54.90±2.76	69.67±1.91	0.0001	72.22±4.53
2	58.17±3.51	69.57±3.08	0.0019	71.31±4.35
3	61.83±2.79	70.31±2.69	0.0163	70.75±3.87
Mean	58.30±1.78	69.85±1.44	0.0020	71.43±2.23
		Comfort temperature		
1	27.36±7.79	13.61±5.91	0.1561	3.14±3.14
2	27.19±9.02	23.85±3.66	0.7255	4.84±3.77
3	16.52±8.68	42.45±1.56	0.0104	15.40±5.54
Mean	23.69±4.81	26.63±3.37	0.6759	7.79±2.77
		Temperature below the comfort		
1	27.07±6.02	82.78±9.16	<.0001	95.52±4.48
2	13.80±4.98	63.62±9.02	0.0001	94.87±4.06
3	2.23±1.08	20.11±5.38	0.0034	70.61±12.6
Mean	14.37±3.29	55.50±7.04	0.0004	87.00±5.48
		Temperature above the comfort		
1	45.56±13.5	3.62±3.48	0.0133	1.34±1.34
2	59.00±9.70	12.54±8.66	0.0025	0.30±0.30
3	81.25±8.62	37.44±6.35	<.0001	13.99±8.30
Mean	61.94±6.71	17.86±4.67	0.0026	5.21±3.16

$P < 0.05$ are significantly different by the F-test.

In general, the polyethylene creep presented the best results of temperature, with the greater percentages of data within the ideal range for piglets in two of the three weeks studied.

Throughout the experimental period, the maternity house had temperature values below the comfort temperature and creeps temperature (Figure 3). Under production conditions, the farrowing room temperature is kept close to 20°C, to prevent excessive thermal stress of the sows, and therefore, negative effects on the milk production and piglet growth (FARMER; PRUNIER, 2002). Hence, it is important to provide extra heating for the piglets. In this way, the polyethylene and wood creeps maintained the temperature at an average of 7.1 and 3.3°C, respectively, in relation to room temperature. The wood creep mean temperature, was more constant than the polyethylene creep, although, the temperature was below the suitable for piglets, especially on the first week, when the thermoregulatory mechanism of the animals are not well developed (Figure 3).

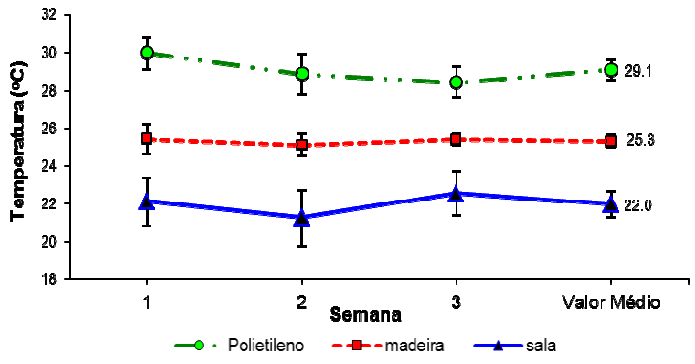

Figure 3 - *Variation of the mean values of creeps and room temperatures , during the study period.*

As expected, the humidity had an inverse temperature trend than observed (Figure 4). The room had higher humidity than the creeps. The wood creep had mean values close to the room humidity, with an average difference of 1.4%, and far above those of polyethylene creep. The humidity inside the polyethylene creep was within the comfort range for piglets (50 to 70%).

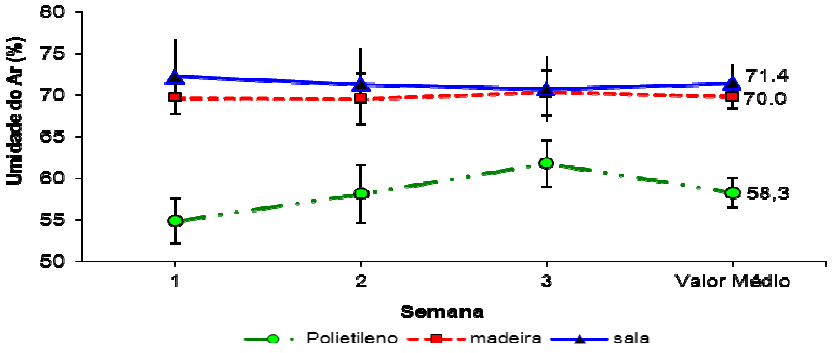

Figure 4 - *Variation humidity mean values for creeps and room, during the study period.*

4 CONCLUSIONS

Both creepers were inefficient in maintaining the temperature within the comfort range for piglets in farrowing house. The creep building materials had influence on the inner air temperature and humidity, and may affect the animals performance. Generally, the polyethylene creep provided better comfort conditions for piglets.

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