EFFECTS OF DIFFERENT LITTER DEPTHS ON ENVIRONMENTAL PARAMETERS AND GROWTH PERFORMANCE OF GROWING-FINISHING PIGS

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INTRODUCTION

The structure of the swine production systems in Brazil changed drastically during the last decades. Feedstuffs and other raw materials are produced far away from the places where the animals are reared. In such places, the waste accumulated surpasses the ground's absorption capacity, as well as the recommendations for their use as fertilizers, which leads to environmental degradation [8]. As a consequence, alternative systems based on assumptions such as low cost, improvement on animal welfare and reduced environmental impact, have called the attention of swine producers [4]. Deep litter systems (DLS) have been eventually implemented by Brazilian pork producers [2], especially during the growing and finishing phases, because it facilitates the waste removal with costs lower than those for traditional systems [4]. DLS use a 50 cm deep litter composed of carbon rich material, such as sawdust and rice husk or cereal peelings [2;3] instead of conventional concrete or plastic floors. The heat needed for composting is produced during the thermophilic phase, in which the temperature inside the litter may be higher than 40ºC for more than 90 days [8]. Thus, raising pigs on DLS, in regions having warm climates or during warmer seasons, may surpass the parameters of environmental comfort during the thermophilic phase of composting [2], which may negatively affect swine growth performance. However, data about the use of litters having depth lower than 50 cm are not available. The objective of this study was to evaluate the effect of the depth of the litter on the environmental parameters within a swine finishing facility located in a region of sub-tropical climate and on growth performance during the growing and finishing phases.

MATERIALS AND METHODS

The experiment was conducted at the Experimental Station of the Universidade Federal de Pelotas, Rio Grande do Sul state, Brazil, at 31º45'S latitude and 52º21'W longitude. The animals were housed in a facility 3.2 m high, covered with ceramic tiles. Three treatments were compared: rice husk 0.5 m deep (T1); rice husk 0.25 m deep (T2); and solid concrete floor (T3). In each treatment, the experimental unit consisted of a 7 m^2 pen with 5 pigs, including a conventional feeder and one nipple drinker. Four repeats (lots) were conducted: L1, from July to September; L2, October to December; L3, from February to April; and L4 from May to July. Two litters were used: the first for L1 and L2; the second for L3 and L4. Those litters were manually scarified between the lots. Each pen included two castrated males and three females (all F1 Landrace x Large White), starting with an average age of 60 days and finishing with an average age of 145 days. Throughout the four repeats, 60 pigs were raised. The pigs were fed *ad libitum* with a 19% crude protein growing diet, having 3350 kcal of metabolizable energy Kg^{-1} and 17% crude protein finishing diet, having 3200 kcal of metabolizable energy Kg^{-1} [5]. Feed consumption was registered for each group, considering the difference between the feed supplied during the period and the feed left at the end of each lot. The pigs were weighted at the days 0, 30, 60 and 85 of the experiment. Those measures were used to calculate feed conversion for each group, following standard procedures. Environmental parameters were determined at weekly intervals. The litter temperature was measured through a Multi-Stem® digital thermometer, at the center of the pen, both in the surface (TSF) and at half of the depth (THD). For T3, the floor temperature was considered as the TSF, but the THD was measured only for T1 and T2. Atmospheric temperature (AT) and relative humidity (RH) were determined 70 cm above the floor surface for each pen. The effects of treatments on the environmental parameters were evaluated by analysis of variance, with comparisons among means conducted by the Tukey test. Mean feed consumption, weight gain and feed conversion were compared by analysis of variance. All statistical analyses were conducted with the [7] software.

RESULTS AND DISCUSSION

Both RH and AT were not influenced by the treatments ($P > 0.05$). Those parameters also did not differ across lots ($P > 0.05$), following similar patterns during the four seasons in which the experiment was conducted. Generally, TSF was lower ($P < 0.0001$) in T3 than in the litter treatments (Table 1), but no difference was observed among litters having different depths ($P > 0.05$). During the experiment, means for feed consumption, weight gain and feed conversions were equal to: 170.2 ± 6.0 kg; 68.7 ± 1.4 kg; and 2.5 ± 0.1, respectively. No growth parameter differed ($P > 0.05$) across treatments. In the litter treatments, TSF values were higher than that observed for the solid concrete floor by at least 6.8℃, although there were no differences between litters having distinct depths. Thus, DLS may impair thermal comfort for growing-finishing pigs, during periods of high environmental temperature, but thermal comfort would be similar among litters regardless of their depths. During the thermophilic phase of L1, TSF varied from 17ºC to 30ºC for T1 and T2, but dropped to 5-7ºC in L3. During this phase in L1, TSF was higher for the deeper litter (T1) than for T2, exceeding 35ºC between weeks 5 and 11, although the temperatures inside the litter reached nearly 60ºC, indicating that the litter allowed an efficient dissipation of the heat produced, since the highest temperatures achieved on the floor surface were 35ºC for T1 and 45ºC for T2. The highest overall TSF were observed for T1 and T2 in L1, and for T1 in L3, when new litters were under the thermophilic phase, with great heat release due to an intense microbial activity [2;8]. For the same reason, THD was also higher for new than for used litters. Those temperatures may influence the behavior of growing-finishing pigs, since they generally lay down on the floor during 60% to 80% of the time, keeping 10% to 20% of their total body surface in contact with the floor [4]. The feed conversion rates in the three treatments were within acceptable limits [3;6], although no differences were observed among treatments and lots. Those findings are in agreement with those of [1], although [2] described that growing-finishing pigs raided on DLS had lower performance than those raised on solid concrete floor. Generally, pigs raised under heat stress show lower growth performance than those raised under thermo neutral conditions [6]. Although the data in the Figure 1 were not statistically compared, since they represent only one observation, they suggest that feed conversion for pigs raised on DLS 25 cm deep was numerically lower than for those raised on DLS 50 cm deep, in both L1 and L2. Feed conversion observed for pigs in the DLS 25 cm deep was similar to those for solid concrete floor, with the exception of L4, in which the feed conversion was poor for all treatments, likely because the pigs were raised during the winter when the thermophilic phase was finished, which may have created unfavorable environmental conditions [4;6]. These results suggest that raising growing-finishing pigs on DLS could be beneficial for growth performance, especially with litters 25 cm deep.

CONCLUSIONS

The environmental parameters analyzed in this study were not affected by the depth of the litter. Considering those results, a litter 25 cm deep would be a cheaper alternative in comparison with a 50 cm deep litter, especially considering the apparent positive effects on growth performance. The use of fans and fog systems in building can be an alternative to minimize the negative effect of deep litter with 50 cm of depth.

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Table 1. Relative humidity (RH), atmospheric temperature (AT), temperature in the surface at the center of the pen (TSF) and at half of the depth (THD) by treatment.

Treatment	RH (%)	AT (℃)	TSF (℃)	THD (℃)
Litter 0.5 m deep	81.3	18.4	26.2^{a}	35.8^{a}
Litter 0.25 m deep	81.5	18.3	24.7^{a}	32.2^{b}
Solid concrete floor	80.6	17.7	17.9^{b}	-
SEM	1.1	0.4	0.5	0.9
n	156	156	156	104

^{a,b}Means ± SEM having distinct superscripts differ by at least $P < 0.05$

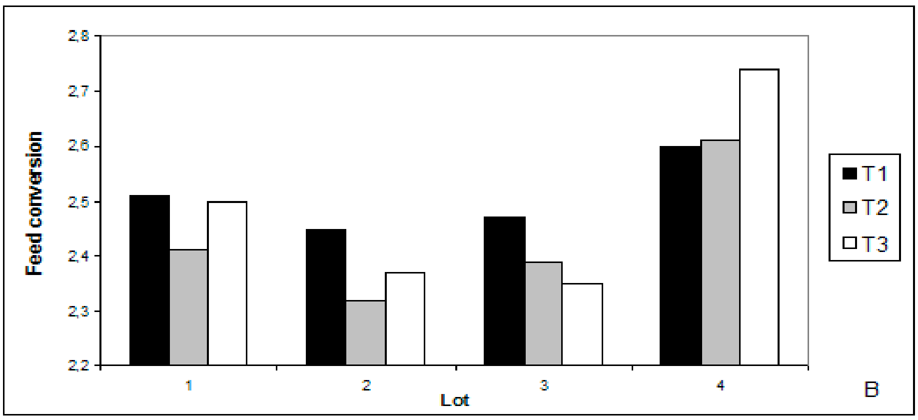

Figure 1. Feed conversion by lot and treatment. T1: Rice husk 0.5 m deep; T2: rice husk 0.25 m deep; T3: solid concrete floor.