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The impact of space allowance on productivity performance and *Salmonella* spp. shedding in nursery pigs

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ABSTRACT

The object of this study was to determine the effect of the area available per piglet, during the nurturing phase, on production performance and presence of *Salmonella* spp. Testing was performed on two farrow-to-finish farms over a period of two years. The study was carried out in three variants: 0.16 m^2, 0.25 m^2 and 0.32 m^2 of floor space per piglet. Pooled faeces samples, which were tested for the presence of *Salmonella* spp., were collected three times during the nurturing stage: 7, 21 and 35 days after weaning. The piglets which had the lowest spatial area available (0.16 m^2) had average daily gain (ADG) significantly lower ($P < 0.05$), and feed conversion ratio (FCR) higher than piglets with 0.25 m^2 and 0.32 m^2 of floor space available. Morbidity and mortality were significantly higher in piglets with 0.16 m^2 of floor space available, compared to piglets housed on larger floor spaces, for both farms examined. The overall presence of *Salmonella* spp. was 6.2% (19/306). Out of 19 *Salmonella*-positive faecal samples, 15 were from piglets with 0.16 m^2 of floor space available (78.9%). The results showed that holding piglets in an area smaller than recommended has no economic justification and may imposes a higher risks of infection of piglets.

1. Introduction

In modern and intensive production of pigs there is a constant need to increase productivity in both the reproductive and capacitive senses. Determination of the floor area needed by each animal requires an allometric approach (Gonyou et al., 2006). Available floor area is directly correlated with piglet's body weight ($A = k \times BW^{2/3}$), where A represents an area in m^2, BW is body weight, and k is a variable coefficient, with currently allowed values in the EU ranging from 0.027 to 0.043, depending on the weight of the pig. The EU Scientific Veterinary Committee recommends that the minimum available area by piglet is calculated using the value of $k = 0.047$ (SVC, 1997), and the same is recommended by the EU Scientific Panel on Animal Health and Welfare, because this is the area which is required for temperatures higher than 25 °C (AHAW, 2005).

With increasing pig housing density, the animals' susceptibility to disease also increases. Recently, pig diseases have become endemic in many countries, and they escalate with the advent of social stress of piglets (Sutherland et al., 2007), which is the result of increasing density of pig populations (Alarcon et al., 2011; Marco-Ramell et al., 2011). Producers of

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pigs always have a goal to produce more animals with better production performances, to be more competitive in the market.

On the other hand, in the global market, food produced in the natural way is becoming more desirable, and consequently, manufacturers' commitment to this type of pig production is also gaining strength. In addition to this, food safety is a very important aspect. It is, therefore, imperative that the pigs are free from those pathogens which are potential causes of human foodborne disease. Pigs infected with *Salmonella* spp. are an important source of *Salmonella* spp. infection in humans. Piglets with confirmed presence of *Salmonella* spp. represent a high risk for contamination of meat, and therefore for safety and health of humans (Beloeil et al., 2004; De Busser et al., 2013). By reducing *Salmonella* spp. in the intestinal tract of piglets, the pressure of contamination of pork is reduced. Funk et al. (2001) in their research found that with increasing density of population of fattened pigs, the presence of *Salmonella* spp. also increased.

The aim of this study was to investigate the effect of the available floor area per piglet during the nurturing phase on the productive performance (average daily gain (ADG), feed conversion ratio (FCR), morbidity and mortality of piglets) and the presence of *Salmonella* spp. in piglets.

2. Material and methods

The testing was performed on two farrow-to-finish farms (A and B) with capacities of 1200 and 2000 sows, respectively, over a period of 2 years (2011–2013). Both farms had the technology based on weekly management. Groups for weekly farrowing were comprised of 60 (farm A) and 110 (farm B) sows. Lactation lasted for 28 (± 3) days, after which the piglets were weaned. The average weight of piglets at weaning was 7.1 (± 0.5) kg. Piglets remained in the nursery for 42 days (22–24 kg), after which they were moved to fattening facilities. Piglets had ad libitum access to feed and water on both farms. The all in/all out principle was used on the farms, and after the completion of each phase, the facilities were cleaned, washed and disinfected.

Both farms used cages for housing piglets in nurseries. The floors were in the form of a grid covering 2/3 of the area, while 1/3 was the heating plate, which was used when the ambient temperature was below 20 °C. Farm A had nurturing boxes with floor areas of 2.8 m^2 (200 × 140 mm), and one pen had 34 boxes. Farm A had 7 pens for breeding piglets. Farm B had boxes with floor areas of 1.65 m^2 (157 × 105 mm) and one pen had 22 boxes. Farm B had 25 pens for breeding piglets.

2.1. Study design

On farm A, 20 groups of piglets were monitored during the study period. Each group had 500 ± 120 piglets. The study was done in three variants in each group: the boxes were filled with 17 piglets (0.16 m^2 per piglet), 11 piglets (0.25 m^2 per piglet) or 9 piglets (0.32 m^2 per piglet). In total, 9900 piglets are examined and, within each group, the piglets were kept with three rearing systems that are examined in this study (Table 1).

On farm B, 14 groups of piglets were monitored during the study period. Each group had 1000 ± 50 piglets. At the start of the study, each group had box was filled with 10 piglets (0.16 m^2 per piglet); 7 piglets (0.25 m^2 per piglet); or 5 piglets (0.32 m^2 per piglet. In total, 13,800 piglets are examined and, within each group, the piglets were kept with three rearing systems that are examined in this study (Table 1).

2.2. Sample collection and laboratory analysis

Pooled faeces samples, examined for the presence of *Salmonella* spp., were collected three times during the nurturing phase: 7, 21 and 35 days after weaning. On farm A, three pooled faecal samples were taken from each of the 20 groups of piglets during each visit. The first faecal sample was taken from the two boxes where piglets were reared in 0.16 m^2 of the space allowance per piglet; the second, from the three boxes where piglets were reared in 0.25 m^2 of the space allowance per piglet; and the third, from the four boxes where piglets were reared in 0.32 m^2 of the space allowance per piglet. So, each sample contained faeces of 35 piglets. In total, 180 samples were analysed from farm A. On farm B, three pooled faecal samples were taken from each of the 14 groups of piglets during each visit. The first faecal sample was taken from the seven boxes where piglets were reared in 0.16 m^2 of the space allowance per piglet; the second, from the ten boxes where piglets were reared in 0.25 m^2 of the space allowance per piglet; and the third, from the fourteen boxes where piglets were reared in 0.32 m^2 of the space allowance per piglet. So, each sample contained faeces of 70 piglets. In total, 126 samples were analysed from farm B. Factors that were evaluated in the process of taking of pooled faeces samples were: presence of diarrhoea in the box, sick animals in the box and slow growth of piglets.

The pooled faecal sample was obtained from the same number of piglets within a farm for all 3 stocking densities.

Faecal samples were collected into sterile containers and transported on ice packs to the laboratory within 2–4 h and cultured immediately. ISO 6579:2002 method was followed. Briefly, each sample was incubated in buffered peptone

Table 1
Number and size of groups studied for the three space allowances.

	Number piglets in group	Number groups	Box size (m^2)	Piglets per box		
				0.16 m^2 /pig	0.25 m^2 /pig	0.32 m^2 /pig
Farm A	500 ± 120	20	2.8	17	11	9
Farm B	1000 ± 50	14	1.65	10	7	5