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Effect of a synthetic plate in the lying area on lying behaviour, degree of fouling and skin lesions at the leg joints of finishing pigs

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ABSTRACT

Flooring type may have a major influence on thermoregulatory behaviour in finishing pigs, as well as on the occurrence of skin lesions at their leg joints and pen fouling. In this study, we compared the lying behaviour, pen fouling and the occurrence of leg lesions in finishing pigs kept in partly slatted pens with a concrete lying area covered with either a non-deformable synthetic plate or a small amount of straw (100 g per pig an day), or left bare, whilst controlling for the effects of temperature and pig weight.

Eighteen groups of 10 finishing pigs each were kept in six replicates in three pens with different floor types as described above. Lying behaviour was videorecorded for 48 h at weights of <35 kg, 50–70 kg and >80 kg. A fouling score for the lying area was estimated daily. Pigs were examined for skin lesions around the carpal and tarsal joints upon introduction into the experimental pens at a mean weight of 28 kg (± 3.9 S.D.) and four times thereafter at regular intervals until they reached 100 kg. Data were analysed using generalised linear mixed-effects models taking the hierarchical experimental design into account.

Floor type in the lying area did not affect the proportion of pigs lying laterally or sternally, or huddling. However, the proportion of pigs lying on the slatted floor was higher in pens with *synthetic plate* flooring compared to those with a *straw* layer and was even lower in pens with *concrete* flooring ($p = 0.015$). Fouling of the lying area increased as room temperatures rose. This increase was sharper in pens with *straw* on the floor than in those with bare *concrete* flooring (interaction: $p = 0.017$), but did not differ between pens with a layer of *straw* and those with a *synthetic plate* flooring (interaction: $p = 0.324$). The likelihood of pigs having hairless patches or hyperkeratosis on the carpal joints was similar in pens with *synthetic plate* flooring and in those with a layer of *straw*, but higher in bare-*concrete*-floored pens. This pattern was also found with respect to the higher prevalence of adventitious bursae at the carpal joints and wounds at the tarsal joints found in pigs kept in pens with synthetic plate flooring.

In conclusion, our results indicate that the synthetic plate flooring studied may cause heat-loss problems, and does not improve floor quality in the lying area as regards skin lesions. From the point of view of pig welfare, it cannot therefore be considered a better alternative to bare concrete floors.

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1. Introduction

In finishing pigs lying on solid or slatted concrete floors, lesions and injuries to the skin of the legs (hairless patches, hyperkeratosis or wounds) as well as adventitious bursae around the tarsal and carpal joints are common

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(Mouttotou et al., 1998, 1999; Mayer and Hauser, 2001). Abrasiveness and hardness of the floor are likely to be the major causes of these lesions. Mayer and Hauser (2001) found that the occurrence of lesions to the skin of finishing pigs was lower in housing systems with straw bedding (300 g straw per pig per day) in the lying area and in deep-litter systems than in pens with fully or partly slatted concrete flooring. However, production costs for rearing pigs are higher in straw-based systems than in litterless systems owing to increased labour input and straw costs. Consequently, less abrasive flooring materials capable of reducing skin lesions to a similar extent to straw bedding would be advantageous. Synthetic lying mats could potentially be such an alternative. Tuytens et al. (2004) reported that sows showed a preference for spending time in lying areas with soft synthetic mats. Unfortunately, however, soft mats are easily destroyed by the pigs within a short period of time (Gut et al., 2001; Tuytens et al., 2004). The present study therefore aimed to test a more durable new flooring material, i.e. a synthetic plate consisting of a hard plastic layer topped with a non-deformable rubber coating with nubs.

Synthetic materials do provide a degree of insulation, however, and might thus influence the thermoregulatory behaviour of the pigs. To disperse excess body heat, finishing pigs increase the amount of body surface in contact with the floor by means of less sternal and more lateral lying with increasing temperatures (Huynh et al., 2005a). Furthermore, at low temperatures pigs display increased huddling behaviour in order to reduce heat loss (Hillmann et al., 2004a; Huynh et al., 2005a). When pigs are kept in pens with an insulating flooring material such as the synthetic plate, these thermoregulatory behaviours are likely to be observed at different temperature ranges compared to pigs in pens with a bare concrete floor. Moreover, in partly slatted housing systems, pigs use the slatted dunging area for resting at high temperatures to increase heat loss (Hillmann et al., 2004a; Huynh et al., 2005a; Aarnink et al., 2006), and this shift in spatial preference for lying might occur at lower temperatures in pens with a synthetic plate in the lying area. Once the slatted floor is preferred for resting, pigs also start defecating and urinating in the former lying area, resulting in increased fouling of the solid floor area, especially at higher temperatures (Huynh et al., 2005a; Aarnink et al., 2006).

In the current study, we aimed to evaluate the advantages for finishing pigs of providing a synthetic plate in the lying area of partly slatted pens in terms of changes in lying behaviour, degree of pen fouling and occurrence of skin lesions around the carpal and tarsal joints. We compared the use of a synthetic plate to bare solid-concrete flooring and to concrete covered with a small amount of straw (100 g per pig per day). To control for possible effects of the insulation provided by the synthetic plate and the minimal straw bedding on the pigs' thermoregulatory behaviour and on pen fouling, we included room temperature and body weight as explanatory variables in the statistical analyses. In addition, we checked for damage to the synthetic plate at the end of the study.

2. Materials and methods

2.1. Animals and housing conditions

The experiment was carried out between April 2004 and September 2005 at Agroscope Reckenholz-Tänikon Research Station ART. Eighteen groups of 10 finishing pigs each were kept in six replicates in three pens measuring 4 m × 2.5 m. The pens were divided perpendicular to the longer axis into an area with a slatted floor (25%) and an area with a solid-concrete floor (75%). The solid-concrete floor (0.75 m² per pig) was either covered with a *synthetic plate* (Agroplan® Domimo, thickness 12 mm) or a small amount of straw (100 g per pig per day; *straw*), or left bare (*concrete*). The *synthetic plate* consisted of a hard plastic layer surmounted by a non-deformable rubber coating with nubs (height of nubs 1.5 mm). The slatted area was of concrete (space between slats 18 mm, slat width 10 cm). To avoid a pen effect on lying behaviour, floor types were systematically swapped between the three pens after each set of pigs. At the end of each set's stay, the *synthetic plate* was carefully inspected for damage.

After weaning, pigs were kept in pens with deep straw before being transferred to the experimental pens at a mean weight of 28 kg (±3.9 S.D.) when groups were split but no re-grouping took place. Groups remained stable thereafter throughout the data collection period until slaughter at approximately 100 kg weight. All groups consisted of both females and castrates (at least four animals of the rarer sex) and groups were balanced with regard to weight within the replicates, i.e. had similar means and weight ranges.

Pigs were fed ad libitum using a dry feeder situated at one of the shorter sides of the pen, above the lying area next to a straw rack providing ad libitum access to straw. Pigs also had free access to water, provided by a nibble drinker in the slatted floor area.

Ambient temperature was recorded every 10 min with a data logger (HOTDOG) and ranged from 4 °C to 28 °C. The data logger was calibrated and placed at 170 cm from ground level above the experimental pens. Daily mean temperatures were calculated for inclusion in the statistical analyses.

2.2. Lying behaviour

Lying behaviour was observed for 48 h using videorecordings made at weights of <35 kg (light weight: LW), 50–70 kg (medium weight: MW) and >80 kg (high weight: HW). Pens were dimly illuminated during the night to allow videorecording. Behaviour was analysed using scan samples at 15-min intervals. We recorded the number of animals lying laterally (flat on one side of their bodies), sternally (on their bellies with three or four legs supporting their bodies), huddling in the lying area (>50% of the area of the side lain on in bodily contact with another pig) or lying on the slatted floor (laterally or sternally in the pen area with slatted floor).

For statistical analysis, the proportion of animals in the different lying postures was calculated per scan interval and averaged per day. The size of the slatted floor meant that it was not always possible for all pigs to lie on it

simultaneously, so the proportion of occupied area on the slatted floor was used instead. This was calculated by dividing the number of pigs lying on the slatted floor by the maximum number of pigs that could potentially lie in this area. The latter figure was in turn calculated by dividing the slatted floor area (2.5 m²) by the space occupied by one pig lying sternally, estimated on the basis of Petherick and Baxter's formula (1981; $0.019 \times W^{0.66}$, W = average group weight). Depending on the age class, the maximum number of pigs that could lie simultaneously in the slatted floor area ranged from 6 to 16 animals.

2.3. Fouling of the lying area

In order to score the fouling of the lying area, the solid floor area was divided into four sectors of equal size (1.5 m × 1.25 m). The area of fouled solid floor was estimated every morning before the pen was cleaned using a scoring scheme with values between 0 (no fouling) and 3 (totally fouled) for each sector. For the statistical analysis, the four fouling scores per pen and day were summed and assigned to the three weight classes of <50 kg, 50–80 kg and >80 kg.

2.4. Examination of the leg joints

The leg joints of the individual pigs were examined according to the Ekesbo method (1984) as described by Mayer and Hauser (2001). The skin at the carpal and tarsal joints (hock; lateral part of the tarsal joint and medial part of the carpal joint) of all pigs was checked for lesions by a single observer (PS) upon introduction of the pigs into the pen at a mean weight of 28 kg (± 3.9 S.D.) and four times thereafter at regular intervals until they reached approximately 100 kg. These examinations corresponded to weight classes of <35 kg, 35–50 kg, 50–70 kg, 70–90 kg and >90 kg. Tarsal and carpal joints were examined for several types of lesions of increasing severity, i.e. for hairless patches, hyperkeratosis, adventitious bursae and wounds. Hyperkeratosis is a thickening of the outer layer of the skin, which contains keratin. This thickening can be viewed as a part of the skin's normal protection against rubbing and pressure. An adventitious bursa is a fluid-filled sac which develops in the subcutaneous connective tissue (Adams 1974, cited by Mouttotou et al., 1999). The bursae can remain as fluid-filled sacs or become solid after the formation of connective tissue. A wound is an abraded area of the skin. Wounds can be open or covered with scabs.

For the statistical analysis, the most severe finding at each examination for each of the two leg joints (carpal and tarsal) was chosen, with individual pigs being characterised by the occurrence of this finding.

2.5. Statistical analyses

Generalised mixed-effects models ('lme' method, Pinheiro and Bates, 2000 and 'glmmPQL' method, Venables and Ripley, 2002) were used to evaluate the data in R 1.9.1 (R Development Core Team, 2004).

In the analysis of the effects of the different floor types on lying behaviour, the response variables, proportion of

pigs lying laterally and sternally or huddling in the lying area, and the proportion of occupied area of the slatted floor were modelled by the fixed-effects floor type of the lying area (factor with 3 levels: *straw*, *synthetic plate*, *concrete*), room temperature (°C, continuous), a quadratic effect of room temperature (to account for curvature in the relationship, °C², continuous), weight class (factor with 3 levels: <35 kg, 50–70 kg, >80 kg) and all possible two-way interactions. We also included the hierarchically nested random effects of measurement point (at the different weight classes) within group within set.

Statistical assumptions in these models were that the random effects on each hierarchical level and the errors are independently and identically distributed with mean zero and some estimated variability. These assumptions of normally distributed residuals and random effects, homoscedasticity of the residuals and independence of the residuals from the explanatory variables were checked using graphical analysis of residuals. To satisfy assumptions of the statistical models, responses were log-transformed (lying sternally) or square-root transformed (proportion of area of slatted floor occupied). Since the distribution of the proportion of huddling pigs was highly skewed, including numerous zero values, it was dichotomised and evaluated using the binomial distribution. Neither the fouling score nor its square-root transformation met the statistical assumptions of normally distributed residuals, and this variable was thus modelled using a Poisson distribution.

The fouling score of the lying area was used as a response variable in a mixed-effects Poisson regression as a function of the fixed-effects floor type of the lying area, room temperature (both as above), weight class (factor with 3 levels: <50 kg, 50–80 kg, >80 kg), pen location within barn (factor with 3 levels) and all possible two-way interactions, as well as by the hierarchically nested random effects of measurement point within group within set.

The probability of leg lesions, i.e. the occurrence of hairless patches, hyperkeratosis, adventitious bursae or wounds, was modelled using the binomial distribution family as a function of the fixed-effects floor type of the lying area (as above), weight class (continuous with values 1, ..., 5 corresponding to the weight classes <35 kg, 35–50 kg, 50–70 kg, 70–90 kg and >90 kg), the weight class squared, cubed and to the power of four (to account for non-linearity in the relationship of lesions and weight classes; these polynomials correspond to using weight class as an ordered factor), sex, and the two-way interaction between floor type and weight class. Animal nested within group nested within set served as random effects.

In the generalised mixed-effects models (Poisson and binomial), the normal distribution of the random effects was again checked graphically. In all models, non-significant interactions were dropped from the model but main effects were retained. Whereas a likelihood-ratio test with pseudo- F values is possible with normally distributed residuals, this approach is not correct for the generalised forms of the model. In the latter case, a sensible approximation is the t -statistic based on the parameter

estimates and their estimated standard error (Pineiro, personal communication; Ripley, personal communication). Because we were only interested in the main effects of the floor type in the lying area, room temperature or weight class, it is only these effects and their significant interactions that are presented in Section 3.

3. Results

3.1. Lying behaviour

The proportion of pigs lying laterally in the lying area did not differ significantly between groups with *synthetic plate*, *straw* and *concrete* ($F_{2,10} = 0.0$; $p = 0.997$). We did, however, discover a significant interaction between weight classes and the quadratic effect of ambient temperature ($F_{2,26} = 6.96$; $p = 0.004$): with increasing temperature, the proportion of LW and MW pigs lying laterally increased up to 20 °C and 15 °C, respectively (Fig. 1), decreasing once more at higher temperatures. Conversely, the proportion of HW pigs lying laterally decreased with increasing room temperature up to 19 °C, increasing slightly at higher temperatures.

The proportion of pigs lying sternally in the lying area decreased with increasing room temperature ($F_{1,31} = 25.28$; $p < 0.001$; Fig. 1) and with increasing weight class ($F_{2,31} = 7.68$; $p = 0.002$). No significant differences between the various floor types were found ($F_{2,10} = 0.05$; $p = 0.948$).

The likelihood of pigs huddling in the lying area did not differ between *synthetic plate* and *straw* ($t_{10} = 0.36$; $p = 0.725$) or between *concrete* and *straw* ($t_{10} = 1.03$; $p = 0.327$; Fig. 1). With increasing temperature ($t_{31} = -3.82$, $p < 0.001$) and increasing weight (MW: $t_{31} = -2.92$; $p = 0.006$; HW: $t_{31} = -4.1$; $p < 0.001$ compared to LW), there was a decreasing likelihood of pigs huddling. There were very few days on which HW pigs actually huddled at all.

The slatted floor was more frequently used for lying as temperatures increased (Fig. 1), an effect which again differed between weight classes (temperature \times weight-class interaction: $F_{2,29} = 3.28$; $p = 0.052$), with this increase being less pronounced in LW than in MW and HW pigs. The proportion of pigs lying on the slatted floor decreased progressively from pens with a *synthetic plate*, to those with *straw*, to those with *concrete* flooring ($F_{2,10} = 6.66$; $p = 0.015$; Fig. 1).

Even after playing host to six replicates of pigs, the *synthetic plate* was scarcely damaged by the investigative and manipulative behaviour of the animals. There were only minor signs of gnawing along the border of the lying area to the slatted floor area, and the nubs on top of the plate were also in good condition.

3.2. Fouling of the lying area

Fouling of the lying area increased with increasing room temperature (Fig. 2). The increase was more strongly associated with temperature in pens with *straw* than in pens with *concrete* (interaction: $t_{1276} = -2.4$; $p = 0.017$; Fig. 2) but did not differ between pens with *straw* and those

with a *synthetic plate* (interaction: $t_{1276} = -0.99$, $p = 0.324$). MW ($t_{32} = 3.3$; $p = 0.001$) and HW pigs ($t_{32} = 5.35$; $p < 0.001$) fouled the lying area to an increasingly greater extent than LW pigs (Fig. 2).

3.3. Examination of the leg joints

As pigs were kept in pens with deep straw litter before being introduced into the experimental pens, those weighing <35 kg showed only minor lesions at the time of their first examination (Fig. 3). The likelihood of pigs having a hairless patch on their carpal joints was greater on *concrete* (OR = 3.2, $t_{10} = 4.4$, $p = 0.001$) than on *straw*, rising sharply up to the second examination at a weight of 35–50 kg, and levelling off thereafter (weight class: $t_{589} = 9.14$, $p < 0.001$; weight class squared: $t_{589} = -7.6$, $p < 0.001$; Fig. 3) (OR = 1.3, $t_{10} = 1.06$, $p = 0.313$). After the second examination, over 50% of pigs were observed to have hairless patches at the carpal joints. The probability of hairless patches at the tarsal joints was not significantly different on *concrete* (OR = 1.9, $t_{10} = 1.24$, $p = 0.244$) or on a *synthetic plate* (OR = 0.97, $t_{10} = -0.06$, $p = 0.950$) than on *straw*, increasing up to the second examination at 35–50 kg, after which it decreased (weight class: $t_{588} = 6.49$, $p < 0.001$; weight class squared: $t_{588} = -5.85$, $p < 0.001$; weight class cubed: $t_{588} = 5.25$, $p < 0.001$; Fig. 3). Again, the main increase was from the first to the second examination.

The likelihood of pigs having hyperkeratosis at the carpal joints showed a similar pattern to that of the hairless patches, with an increased probability on *concrete* (OR = 5.0, $t_{10} = 4.27$, $p = 0.014$) compared to *straw* and a temporal pattern with a marked increase up to the second examination, after which the probability levelled off (weight class: $t_{589} = 9.27$, $p < 0.001$; weight class squared: $t_{589} = -8.7$, $p < 0.001$; Fig. 3). No difference was found between the *synthetic plate* and *straw* treatments (OR = 1.9, $t_{10} = 1.71$, $p = 0.118$). Hyperkeratosis was observed less frequently at the tarsal than at the carpal joints (Fig. 3). The likelihood of hyperkeratosis in the tarsal joints did not differ on *concrete* (OR = 1.1, $t_{10} = 0.16$, $p = 0.873$) or on *synthetic plate* (OR = 1.1, $t_{10} = 0.16$, $p = 0.877$) compared to *straw*, and was high at the time of the second examination, after which it dropped to near-baseline levels (weight class: $t_{588} = 2.64$, $p = 0.008$; weight class squared: $t_{588} = -2.73$, $p = 0.007$; weight class cubed: $t_{588} = 2.63$, $p = 0.009$; Fig. 3).

The probability of pigs having adventitious bursae at the carpal joints increased more rapidly with increasing weight on *synthetic plate* (interaction: $t_{588} = 5.75$, $p < 0.001$) but at a similar rate on *concrete* (interaction: $t_{588} = -0.02$, $p = 0.982$; Fig. 3) compared to *straw* (weight: $t_{588} = 3.39$, $p < 0.001$). This resulted in higher observed probabilities for the *synthetic plate* at most weight classes (Fig. 3). An analogous effect was found for adventitious bursae at the tarsal joints, with a steeper increase on *concrete* (interaction: $t_{587} = 2.39$, $p = 0.018$) and a similar increase on *synthetic plate* (interaction: $t_{587} = -0.13$, $p = 0.895$; Fig. 3) compared to *straw*. The increase on *concrete* was steady up until the final examination at >90 kg. The general increase in the likelihood of adven-

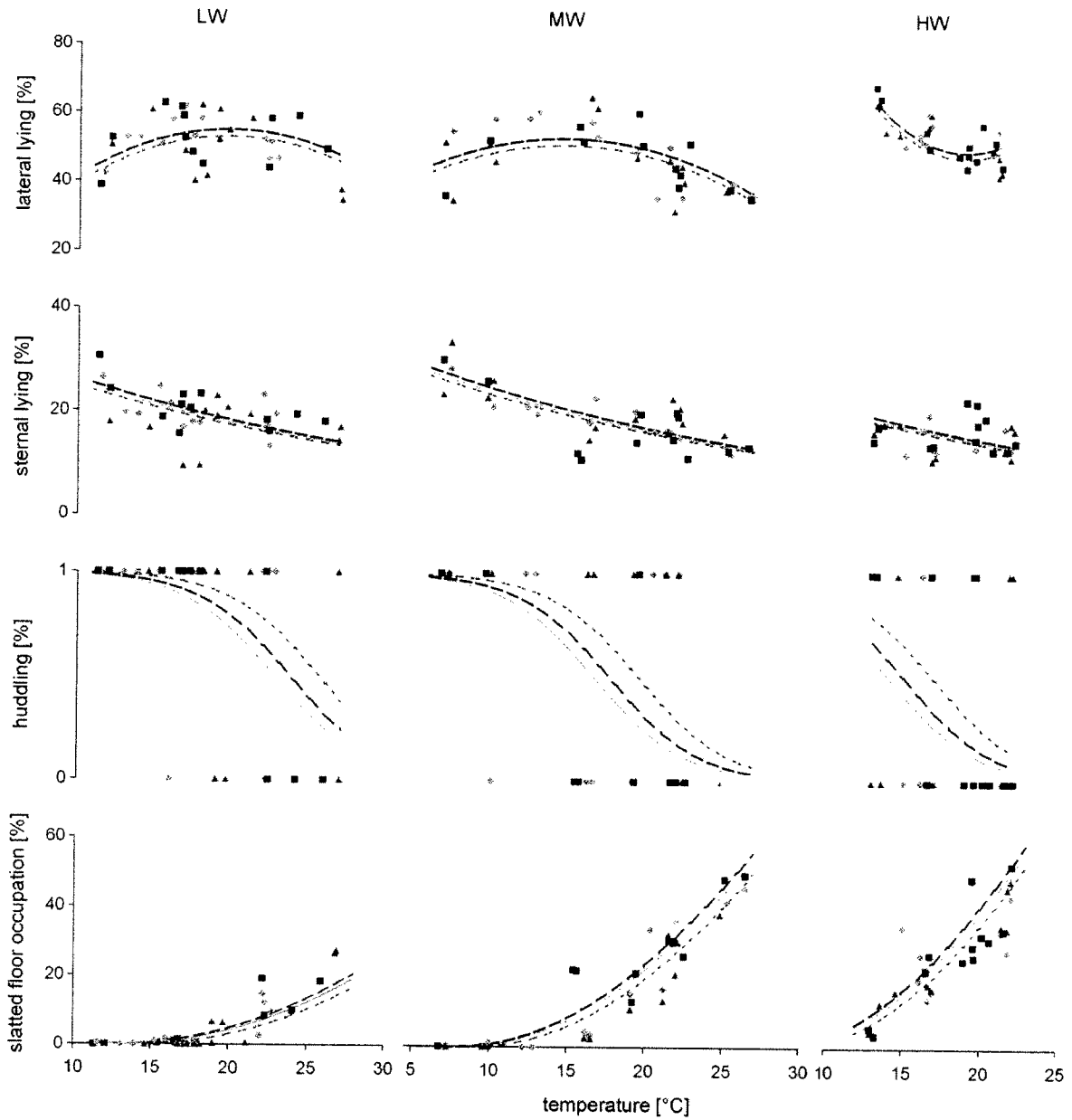


Fig. 1. Proportion of pigs displaying different lying postures in the lying area (lateral lying, sternal lying or huddling) and proportion of occupied area on the slatted floor in relation to room temperature and weight class (LW: light weight; MW: medium weight; HW: high weight). Means per group and day: (■) synthetic plate, (*) straw and (▲) concrete. Model estimates: (—) synthetic plate, (---) straw and (.....) concrete.

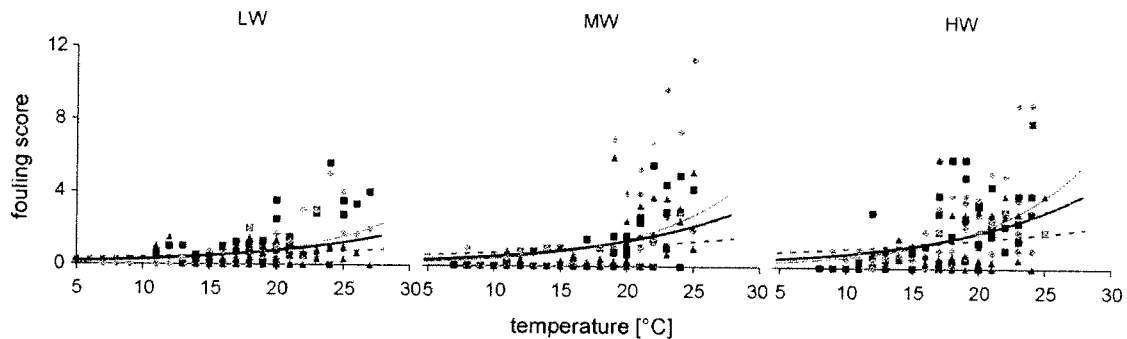


Fig. 2. Fouling score of the lying area in relation to room temperature and weight class (LW: light weight; MW: medium weight; HW: high weight). Scores per day and group: (■) synthetic plate, (*) straw and (▲) concrete. Model estimates: (—) synthetic plate, (---) straw and (.....) concrete.

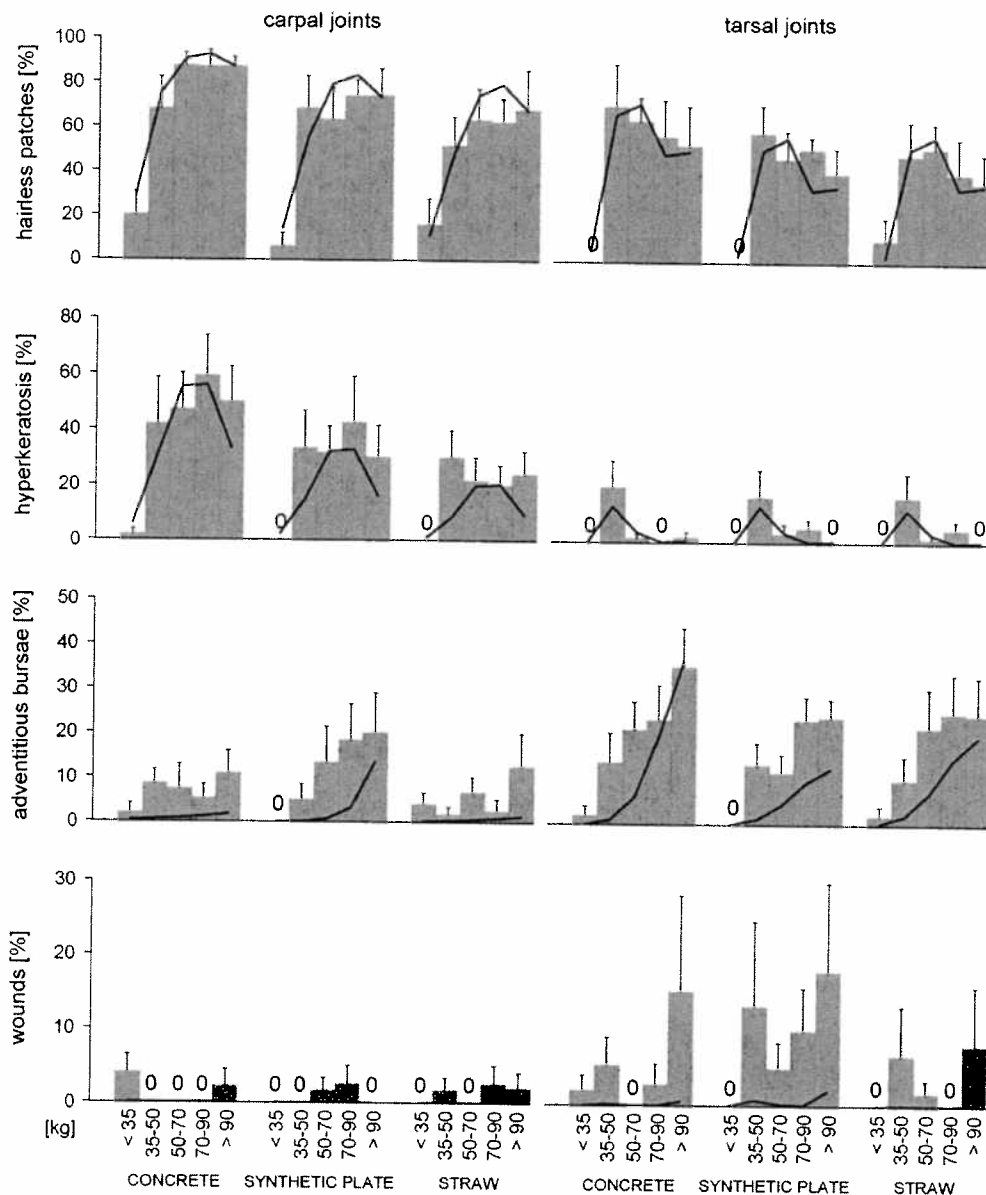


Fig. 3. Proportion of finishing pigs (mean and standard errors across groups) with at least one hairless patch or one instance of hyperkeratosis, adventitious bursae or wounds at the carpal or tarsal joints in relation to floor type in the lying area and body weight. Lines reflect the fitted models.

adventitious bursae was higher for the tarsal than for the carpal joints (Fig. 3).

Wounds were rare at the carpal joints, and accordingly the probability was low, with no dependence on floor type (*concrete*: $OR = 1.7$, $t_{10} = 0.41$, $p = 0.688$; *synthetic plate*: $OR = 1.0$, $t_{10} = -0.02$, $p = 0.988$, compared to *straw*) and no effect of weight class (weight class: $t_{590} = 0.78$, $p = 0.438$; Fig. 3). The likelihood of pigs having wounds was higher at the tarsal than at the carpal joints (Fig. 3). This was observed especially on *synthetic plate* ($OR = 7.5$, $t_{10} = 3.51$, $p = 0.006$), but not on *concrete* ($OR = 2.2$, $t_{10} = 1.28$, $p = 0.230$), compared to *straw*, with an increase at low weights and a larger increase late in the finishing period (weight class: $t_{588} = 8.62$, $p < 0.001$; weight class squared: $t_{588} = -9.10$, $p < 0.001$; weight class cubed: $t_{588} = 9.47$, $p < 0.001$; Fig. 3).

4. Discussion

In this study, we compared the behaviour and the occurrence of leg lesions in finishing pigs kept in partly slatted pens with a concrete lying area covered with either a synthetic plate or a small amount of straw, or left bare, whilst controlling for the effects of temperature and pig weight. In accordance with other studies (Eckel et al., 2003; Hillmann et al., 2004a; Huynh et al., 2005a), we found that temperature and pig weight had significant effects on lying behaviour. The proportion of pigs lying sternally in the lying area decreased with increasing room temperature and with increasing weight class, whereas the probability of pigs huddling increased with decreasing temperature and decreasing weight. With regard to lying laterally in the lying area, we found a significant

interaction between weight class and the quadratic effect of ambient temperature, which showed that pigs of different weight classes varied in terms of behavioural reaction to increasing room temperature. This was also true for the proportion of pigs using the slatted floor area for lying—a proportion which increased more sharply with rising temperatures in high- and medium-weight pigs than in light-weight pigs. In summary, these results support the notion that lying behaviour has an important thermo-regulatory function in pigs (Hillmann et al., 2004b; Huynh et al., 2005b).

We found no differences between the floor types tested in the present study in terms of the proportions of pigs adopting different lying postures. However, the proportion of pigs lying on the slatted floor decreased significantly from pens with a *synthetic plate* to those with *straw*, and further to those with bare *concrete*. This is hardly surprising, since the *synthetic plate* provided more insulation than concrete, and the amount of straw used in the *straw* treatment (100 g per pig per day) was obviously not sufficient to cover the whole lying area and insulate the concrete floor. As a result of the shift in spatial preferences for lying with increasing room temperature, pen fouling increased for all floor types at higher temperatures, an effect which was significantly more pronounced in pens with the *synthetic plate* or *straw* compared to the bare *concrete* treatment. Moreover, medium- and high-weight pigs fouled the lying area more than light-weight pigs. The observed effects of temperature and body weight on pen fouling are in accordance with those found in previous studies (Hacker et al., 1994; Aarnink et al., 1997, 2006; Huynh et al., 2005a). In terms of floor quality in the lying area, Zonderland et al. (2001) and Spoolder et al. (2000) also found that pen fouling was higher in finishing pigs kept both in pens with a lying area of solid concrete littered with straw and in pens with a solid sloping floor with straw bedding, than in those kept on a bare solid-concrete floor. Gut et al. (2001) reported problems with pen fouling in a pilot study using rubber mats in the lying area of pens for finishing pigs.

Before their introduction into the experimental pens, pigs were kept in pens with deep straw litter. The overall prevalence of injuries at the leg joints was therefore low at the time of introduction into the pens (weight class <35 kg). Between the first and second investigations, however, the percentage of pigs with hairless patches and hyperkeratosis at the carpal and tarsal joints increased markedly—findings which may be explained by the change from a soft (i.e. deep straw) to a hard lying area. Later on during the fattening period, the occurrence of these types of lesions remained at a similar level or decreased slightly, indicating that floor quality was most relevant in terms of skin lesions to the leg joints in the first week after introduction to the fattening-housing system.

In keeping with the results of previous studies (Mayer and Hauser, 2001; Cagienard et al., 2005), we found that the likelihood of pigs having hairless patches or hyperkeratosis at the carpal joints was greater on *concrete* than on *straw*. In terms of the occurrence of these less severe types of lesions, the *synthetic plate* did not differ from the *straw* treatment. By contrast, adventitious bursae at the carpal

joints and wounds at the tarsal joints were most prevalent in pens with the *synthetic plate*, showing that this floor type tended to cause lesions likely to be associated with pain. These lesions may have been caused by the nubs on the surface of the *synthetic plate*. Finally, in keeping with the findings of Mouttoutu et al. (1998), we found a steeper increase in the occurrence of adventitious bursae at the tarsal joints on *concrete* than on *straw*.

5. Conclusion

The *synthetic plate* evaluated in this study proved resistant to several replicates of finishing pigs, and can thus be seen to be more durable than softer *synthetic lying mats* found in previous studies to be unsuitable for use in housing systems for pigs. Nevertheless, our results indicate that the pigs avoid lying on the *synthetic plate* and start lying in the dung area at lower temperatures than when lying on concrete, either due to the higher insulation provided by the *synthetic plate* that may cause heat-loss problems or due to a reduced comfort caused by the nubs on the surface of the *synthetic plate*. The *synthetic plate* did not improve the quality of the lying area in terms of reducing the incidence or severity of skin lesions, and severe types of lesions (adventitious bursae and wounds) were even more prevalent in pens with this type of flooring than in pens with bare concrete in the lying area. In terms of pig welfare, therefore, the *synthetic plate* cannot be considered a better alternative to bare concrete.

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