



## Original Scientific Article

**POSTURAL BEHAVIOUR IN GILTS HOUSED ON CONCRETE  
AND RUBBER SLATS DURING FOUR SEASONS**

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**ABSTRACT**

In the present study, postural behaviour was compared between gilts kept in service unit with different types of flooring during all seasons. The study included four 28-day production cycles and 10 gilts *per* cycle, equally divided into a control and an experimental group. Control gilts were housed in gestation stalls with slatted concrete floor, whereas in the experimental group the floor was covered with an adjusted rubber mat. Postural behaviour of gilts was observed 4 times *per* cycle for 4 hours. Study results showed that during cooler seasons, gilts in concrete stalls spent more time standing and lying sternally, whereas gilts in matted stalls were mostly lying, predominantly laterally ( $P < 0.001$  all). There were no significant between group differences according to the time the gilts spent sitting or the frequency of changing posture in any season observed. Nevertheless, experimental animals spent significantly less time changing standing to both lying positions during all seasons ( $P < 0.01$  all). In conclusion, rubber mats may improve lying comfort in gilts; however, when using rubber mats, the house thermal conditions should be taken in consideration.

**Key words:** gilts, rubber mats, postural behaviour, welfare

**INTRODUCTION**

Historically, pigs were traditionally kept in small to medium herds, in simple housings with straw mostly used as litter for providing comfort and warmth. Over time, pig keeping has been restricted to closed housings with a large number of animals, aiming at increasing the productivity and reducing the cost of pig breeding. This type of pig accommodation required flooring changes. The use of slatted and semi-slatted flooring that requires

no litter has become an imperative in pig breeding. However, the new production systems have been found to compromise animal welfare (1).

When kept on slatted and semi-slatted flooring, pigs cannot express their species specific behaviours such as routing or nest building. In addition, pigs prefer lying on solid rather than slatted floor, since the former is warmer (2). As reported by Huynh et al. (3), surface temperature of slatted floor is generally lower by 3-5°C as compared with solid floor. Even more so, the housing air quality is lower with slatted flooring (4).

With regards to the type of material, concrete is usually used in flooring construction in animal housing (5, 6). Concrete is a durable and relatively inexpensive material, acceptable for maintaining hygiene in these housings. However, the hard, rough and slippery concrete flooring has adverse effects on animal welfare (7). Another disadvantage of concrete flooring in comparison with straw bedding is that it considerably increases the lower

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critical temperature (8). Therefore, the possibilities of improving concrete floor conditions in pig breeding housing have been investigated, with due consideration of their ecologically acceptable properties. One of these attempts implies the use of rubber mats, whereby previous studies have mostly been focused on the injuries and behaviours of lactating and group-housed pregnant sows (9-17).

Flooring comfort is very important in intensive pig breeding because pigs spend up to 80% of time lying (1) when 8% to 20% of the pig body is in contact with the flooring (18). It is even more important when pigs are kept on a relatively small surface (19), as in the case of individual accommodation of pregnant sows.

In the present study, the effect of rubber mats on the welfare of individually kept gilts in a service unit was assessed by observing their postural behaviours.

## MATERIALS AND METHODS

The study was carried out at a pig farm service unit in all seasons of the year during four production cycles, according to the availability of gilts, as follows: May-June (spring), September (summer), November (autumn) and December-January (winter). Each cycle took 28 days. According to the Council Directive 2008/120/EC (20), during this period, breeding females in pig production are usually kept individually in a service unit postmating.

The study included 40 Large White gilts, 10 animals *per* cycle, randomly divided into two equal groups, a control and an experimental group. Control gilts were kept in usual production conditions, i.e. in gestation stalls (L 1.80 m x W 0.60 m) with slatted concrete floor (slat width 80 mm, gap width 20 mm). The concrete floor was in good repair, with no signs of degradation. Experimental animals were kept in identical conditions except for the stall floor being coated with 2-cm adjusted rubber mat of a plug-like pattern (Gumiimpex-GRP Inc., Croatia). Although the rubber mat was not formally tested for comfort properties, its texture appeared softer and less abradant than the concrete floor in the service unit. Rubber mats were connected using the puzzle pattern and attached to the concrete floor. Upon completion of a study cycle, the mats were disconnected, sanitized, and then fitted again before the next cycle.

For about a week before transfer to the service unit, gilts were group-housed in the area intended for sows after weaning, where they had been transported from the group-housed breeding facility for gilts situated on the farm, but separated from other housing. Gilts were transferred from the breeding facility at the age of 6-8 months, when their

body mass was around 100 kg. Synchronization of oestrus was previously performed (PG 600 hormone agent, Intervet, The Netherlands) for all gilts to be accommodated in the service unit simultaneously during each cycle observed. Upon synchronization, gilts underwent fertilization on day 5 in the afternoon and then again on day 6 in the morning, to be accommodated in the service unit on day 7 in the morning. As the study gilts were included in the farm technology and production organization, gravidity was diagnosed as usual, during the 4<sup>th</sup> week of the production cycle in the service unit.

In the service unit, gilts are fed concentrated feed twice a day (7.30 AM and 13.00 PM) with water supply *ad libitum*. The housing has natural and artificial illumination (for at least 8 h/day) and forced ventilation. During the cold season, no heating is provided, but acceptable microclimate conditions are achieved by reduced ventilation.

The time the gilts spent in different positions (min), the frequency (n) and duration (sec) of body posture changes were recorded on days 1, 8, 15 and 28 of each cycle. Gilt behaviour was recorded by two digital video cameras (Toshiba Camileo P30, China), fixed on a support, each camera covering one group of gilts. As the study was performed on a commercial pig farm, recording was limited to 4 hours (from 8.30 AM to 12.30 PM). Upon completion, video recordings were examined and the ethogram was developed including the following postures: standing, sitting, lying laterally and lying sternally.

During the study period, air temperature in the service unit was measured using the portable Testo digital device (Testo Inc., Germany).

Licensed STATISTICA 6.1 software (StatSoft Inc., 1983-2003) was used on statistical data processing and analysis. Distribution of the parameters of posture duration, number and length of posture changes was tested by the distribution fitting test, which yielded normal distribution. The impact of study factors (group, cycle and day) and their interactions on all study parameters (dependent variables) and between-group differences in each parameter during particular cycles were tested by the Generalized Linear Model - Factorial ANOVA. Correlation of air temperature in the service unit with posture duration and number of posture changes was tested by regression analysis.

## RESULTS

The provision of rubber mats very strongly affected the body postures of the gilts in the autumn and winter periods. The lower the air temperature in the service unit (Figure 4), the more time did the

experimental gilts spend lying in total and lying laterally ( $P<0.001$  both) (Table 1).

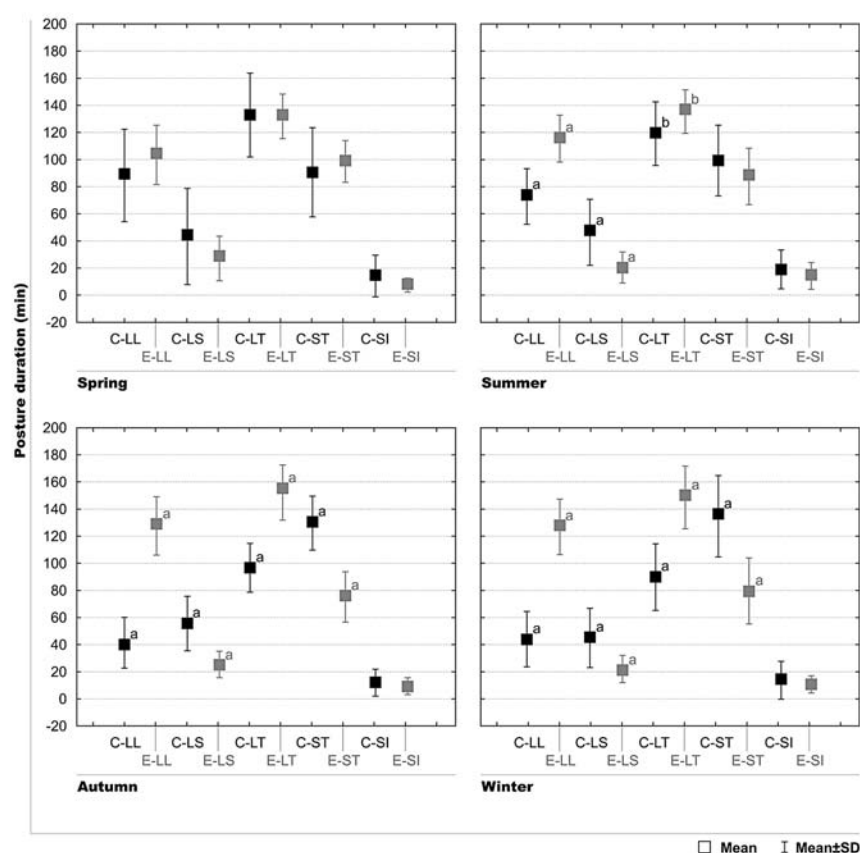
**Table 1.** Correlation of service unit air temperature with the length of time the gilts spent in particular postures and posture changes in the control (concrete stalls) and the experimental groups (matted stalls)

Control Experimental	Temperature (°C)
Standing (min)	-0.552* 0.396*
Sitting (min)	0.142 0.167
Lying in total (min)	0.541* -0.480*
Lying laterally (min)	0.607* -0.437*
Lying sternally (min)	-0.107 -0.023
Posture change (n)	0.557* 0.338**

\* $P<0.001$ , \*\* $P<0.01$

The gilts provided with rubber mats spent up to 40% more time lying in total compared to gilts housed on concrete slats in autumn and winter ( $P<0.001$  both). Experimental gilts spent over 50% of their time lying laterally, whereas control gilts assumed this position in less than 20% of the time during these cooler periods ( $P<0.001$  both). On the other hand, gilts in matted stalls spent half as much time lying sternally as compared to control gilts in autumn and winter ( $P<0.001$  both) (Figure 1). However, there was no significant correlation between air temperature and time spent lying sternally in either experimental or control group of gilts (Table 1). Finally, the time spent standing was much shorter on rubber mats in autumn and winter ( $P<0.001$  both) (Figure 1, Table 1).

In comparison with the autumn and winter periods, a significant but weaker difference ( $P<0.05$ ) in total lying and the same level of difference ( $P<0.001$ ) in lying laterally and lying sternally was recorded between experimental and control gilts



**Figure 1.** Time spent in different postures in control (concrete stalls) and experimental (matted stalls) group of gilts during a 4-hour period of observation in 4 different production cycles (seasons)

C-control group, E-experimental group, LL-lying laterally, LS-lying sternally, LT-lying in total, ST-standing, SI-sitting, n=4 recordings per season, n=5 gilts per group and season

<sup>a</sup>The same postures during the same season differed statistically significantly between the two groups at the level of  $P<0.001$

<sup>b</sup>The same postures during the same season differed statistically significantly between the two groups at the level  $P<0.05$

during the summer period. There was no between-group difference in the time spent standing in summer (Figure 1). In the spring period, there was no between-group difference in any body posture (Figure 1).

Of all the postures recorded, both experimental and control gilts spent least time sitting. There was no between-group difference according to the duration of sitting in any of the production cycles observed (Figure 1).

The lower the air temperature in the service unit (Figure 4), the less frequent did both control ( $P<0.001$ ) and experimental ( $P<0.01$ ) gilts change their body posture (Table 1). However, there was no between-group difference in the number of body postures in any of the production cycles observed (Figure 2).

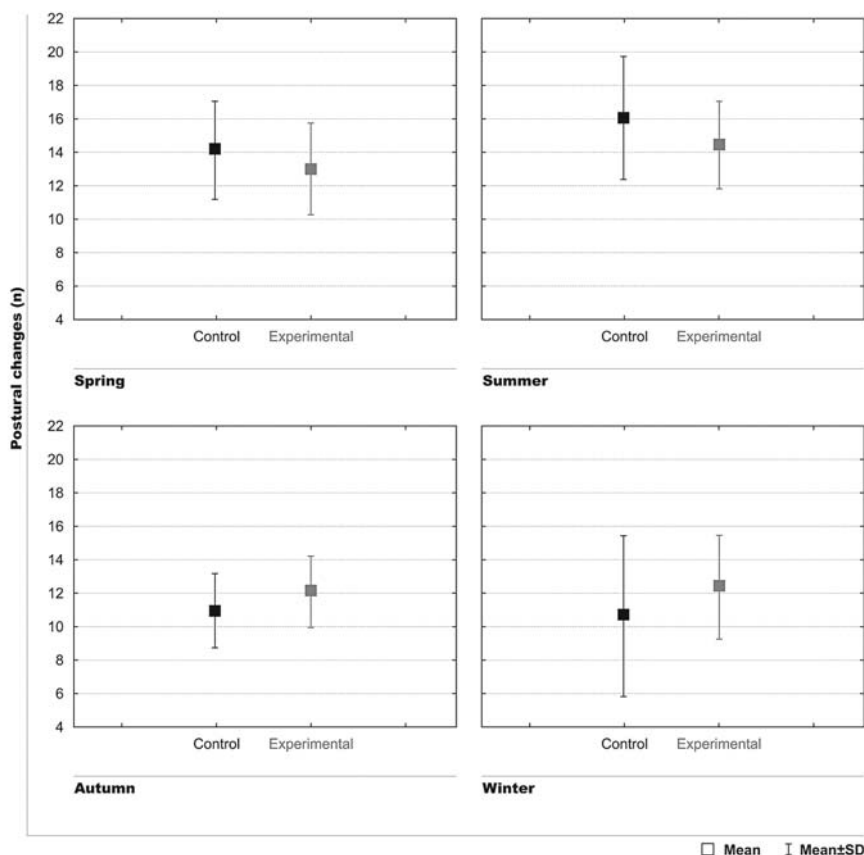
Considering the speed of posture changes, the analysis included only those posture changes for which an adequate amount of data was available. As illustrated in Figure 3, in all seasons the experimental animals used to change faster standing posture to lying laterally ( $P<0.001$  all)

and lying sternally ( $P<0.001$  all except for  $P<0.01$  in the spring production cycle). Concerning other posture changes analysed, lying laterally to standing and sitting, and sitting to standing, there was no significant between-group difference in any season, with the exception of autumn, when experimental gilts spent significantly less time changing their posture from sitting to standing posture ( $P<0.01$ ).

## DISCUSSION

In modern production, pigs are kept in bare ambient conditions threatening animal welfare. Therefore, ever more attention has been paid to alternative systems of accommodation (21, 22). In the present study, concrete flooring for individually housed gilts was covered with rubber mats.

Tuytens et al. (13) and Elmore et al. (14) report that sows preferred to lie on mats during the cold season, i.e. lying laterally, which could be ascribed to the rubber flooring temperature higher by 1.2-6.7 °C than the concrete floor temperature (13). Results of our study confirm their finding. The total time the



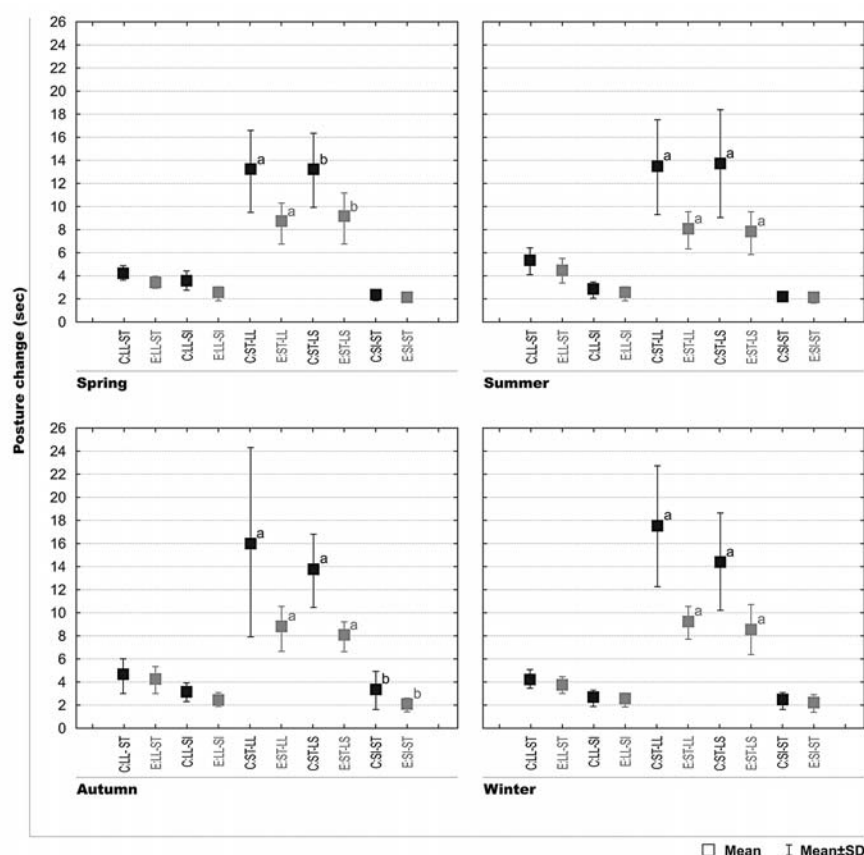
**Figure 2.** Frequency of posture changing in control (concrete stalls) and experimental (matted stalls) group of gilts during a 4-hour period of observation in 4 different production cycles (seasons)  
n=4 recordings per season, n=5 gilts per group and season

gilts spent lying was by about 1 hour longer *per* 4 hours of observation on rubber mats in autumn and winter (Figure 1). If the 4-hour period is extrapolated to 24-hour period, then the gilts on rubber mats will spend 5-6 hours more lying and 5-6 hours less standing daily. The duration of lying laterally was tripled by the provision of mats during cooler autumn and winter seasons (Figure 1). Therefore, the results indicate that thermal and resting comfort of stall housed gilts is dramatically improved by the provision of rubber mats when housing temperature drops below 18 °C (Figure 4).

The lower the air temperature (Figure 4), the more time did experimental gilts spend lying laterally, as the predominant form of resting behaviour in pigs (23), whereas control gilts spent more time standing, and *vice versa* (Table 1). Although air temperature continuously increased during spring and declined during summer, its values were higher in these seasons as compared with autumn and winter (Figure 4) and the gilts housed in matted stalls spent

more time lying laterally in these warmer seasons, however, with a weaker or no detectable effect (Figure 1). This finding could suggest that they felt more comfortable on rubber mats irrespective of air temperature, or that it was too warm, since pigs are known to lie laterally when they are warm because this position enables higher heat output to the environment (24, 25). However, as the rate of lying sternally was halved in gilts housed on rubber slats in all seasons, i.e. higher in control gilts (Figure 1), while no significant correlation was found between the time spent in sternal position and air temperature in either experimental or control group of gilts (Table 1), differences in lying behaviour were probably due to not only thermal properties, but also to other properties of the mats such as softness.

Pigs often assume sitting position when changing from lying to standing position and *vice versa*, but they do not spend much time in sitting position (26), as also confirmed in the present study (Figure 1).



**Figure 3.** Duration of posture changes in control (concrete stalls) and experimental (matted stalls) group of gilts during a 4-hour period of observation in 4 different production cycles (seasons)

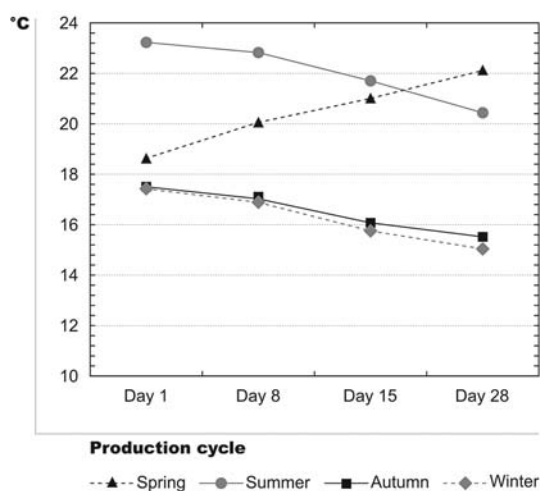
C-control group, E-experimental group, LL-lying laterally, LS-lying sternally, ST-standing, SI-sitting, n=4 recordings per season, n=5 gilts per group and season

<sup>a</sup>The same postures during the same season differed statistically significantly between the two groups at the level of  $P < 0.001$

<sup>b</sup>The same postures during the same season differed statistically significantly between the two groups at the level of  $P < 0.01$



The type of flooring that is inappropriate for pigs will make them feel unsafe when moving around and changing posture, thus restricting their movement and expression of natural behaviour (24). According to Anil et al. (27), the ease of lying down can be used as an indicator of sow comfort. In comparison with control gilts, experimental gilts spent significantly less time changing standing to both lying positions in all seasons (Figure 3). In contrast, the slatted-concrete floor-housed gilts had more difficulties to change these postures. The changes from standing to lying position took much longer, which could be ascribed to the slippery concrete floor as compared with the textured rubber flooring. Tuytens et al. (13) and Elmore et al. (14) found that group-housed sows changed posture more frequently when provided with rubber mats, which is explained by the less uncomfortable and less slippery surface ensuring appropriate friction between pig claws and textured rubber mats. Yet, in the present study there were no significant between-group differences in the number of posture changes (Figure 2). It should be noted, however, that a higher air temperature (Figure 4) was associated with a higher rate of posture changing in both experimental and control groups of gilts (Table 1).



**Figure 4.** Air temperature in the service unit during the study period

Concrete floor slipperiness can result in animal leg and claw injuries with consequential lameness (7). In addition, the risk of injuries and lameness is even greater on slatted floor as compared with solid floor (28, 29). Comparing the injuries and lameness between group-housed sows on concrete slatted floor and rubber slat mats, Calderón Díaz et al. (15)

found the latter to be associated with an increased risk of claw lesions, while upgrading the sow welfare by reducing the risk of lameness and limb injuries. To our knowledge, injuries and lameness in gilts housed individually in rubber floor gestation stalls have not yet been assessed, which should be taken in consideration in future studies.

## CONCLUSION

Study results revealed the use of rubber mats in service unit to result in improved lying comfort in individually accommodated gilts during the cold season, suggesting that the thermal conditions in pig houses should be taken in consideration in using this type of flooring.

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