Impact of environmental enrichment on the behaviour and immune cell transcriptome of pregnant sows

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Detecting onset of farrowing using CUSUM-charts based on sows' activity

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With the latest changes in legislation in Germany, sows are only allowed to be confined in farrowing crates for five days to prevent piglet crushing. Thus, it is important to estimate the onset of farrowing correctly to close the crate just before the farrowing and open it again after the first days to reduce negative effects on sow welfare. Monitoring the activity level of the sow, which increases about 16 to 20 h ante partum due to nest-building activities and restlessness, it is possible to estimate the onset of farrowing. However, doing this with human observation is not feasible under commercial conditions. Therefore, the activity of sows (n=125) was estimated using optical flow (OF, changing of pixels from one frame to the other) of video footage and cost efficient passive infrared motion sensors (PIR) during 96 h ante partum. CUSUM-charts were used to detect a change in activity separately for OF and PIR. To minimise the influence of farm staff moving in the pen, the mean activity was calculated over different time intervals (15, 30, 60 min). Afterwards, the individual activity of every sow was standardised using z-transformation $((x-\mu)/\sigma)$. Thus, every sow had a mean activity of 0 and a standard deviation of 1. This data was used in univariate one-sided CUSUM-charts. The best results of the OF were achieved with mean activity of the 60 min time interval and the combination of h=9 and k=0.25. Here, the increase in activity was correctly detected in 97% of times at a mean of 9 h 7 min (±5 h 31 min standard deviation) before the actual farrowing. The number of false positive alarms (earlier than 24 h before farrowing) was 0.23 per sow. For the PIR, the best results were achieved with 15 min time interval and the combination of h=1.5 and k=0.5. In 91% of times increase of activity was detected at a mean of 16 h 46 min (±7 h 11 min) before the farrowing. Here, the number of false positive alarms was 4.84 per sow. Therefore, using activity monitoring, it is possible to time the closing of the crate more precisely. However, the number of false positive alarms of the PIR motion sensor has to be improved to be of practical interest.

Impact of environmental enrichment on the behaviour and immune cell transcriptome of pregnant sows

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The ability to assess farm animals' mood is important to evaluate their welfare, but practical assessment tools are still lacking. Human research has demonstrated a link between psychological states and the transcriptome of blood immune cells. Therefore, this study aimed to investigate whether blood immune cell transcriptome can be used to assess the animals' mood using environmental enrichment as a method to generate contrasted welfare states. Pregnant sows of mixed parities were housed in two contrasting conditions throughout gestation (0 to 105 days): a conventional system on a slatted floor (C, n=36) or an enriched system on accumulated straw with additional space per sow (E, n=35). The behaviour of multiparous sows of low (2nd and 3rd gestation; n=29) and high (4th gestation or higher; n=31) parity was observed from G99 to G104 and 14 sows per system were selected for biological sampling. Cortisol concentrations in saliva (G35 and G98), and in the hair (G98), were lower in E sows ($P<0.04$). E sows spent more time exploring the pen ($P<0.001$), less time chewing enrichment material ($P<0.001$) or exhibiting stereotypic behaviours ($P=0.04$), and had lower frequencies of agonistic behaviours ($P=0.04$). High-throughput sequencing of the blood mononuclear cell transcriptome (G98) identified only 24 differentially expressed genes (DEGs) between C and E sows (adjusted *P*-value<0.1, FC<0.8 or >1.2). However, parity (894 DEGs) and social dominance (437 DEGs) had a greater effect, and most of the DEGs were related to innate and adaptive immunity pathways. Therefore, these results confirm that long-term environmental enrichment decreases cortisol concentration and positively influences sow behaviour. The blood transcriptome did not allow discrimination between housing conditions but it was influenced by another important factor for welfare, such as social dominance in the group.