



# Prepartum nest-building has an impact on postpartum nursing performance and maternal behaviour in early lactating sows



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## ARTICLE INFO

### Article history:

Received 2 June 2014

Received in revised form 5 August 2014

Accepted 28 August 2014

Available online 6 September 2014

### Keywords:

Sows  
Nest-building  
Oxytocin  
Prolactin  
Maternal behaviour  
Farrowing environment

## ABSTRACT

The effects of facilitating prepartum nest-building (NB) behaviour, by providing abundant nesting materials, on postpartum maternal characteristics in early lactating sows were evaluated. A total of 35 sows, approximately seven days before the expected parturition date, were housed in: (1) CRATE ( $N=11$ ): the farrowing crate closed (210 cm  $\times$  80 cm), with provision of a bucketful of sawdust, (2) PEN ( $N=12$ ): the farrowing crate opened, with provision of a bucketful of sawdust, and (3) NEST ( $N=12$ ): the farrowing crate opened, with provision of abundant nesting materials. Plasma samples were collected from sows, via an indwelling catheter on days  $-3$ ,  $-2$ , and  $-1$  (parturition being day 0) for oxytocin (OT) and prolactin (PRL) assays. Prepartum NB behaviour was observed in sows for a 20 min period for each hour from 18 h to parturition until birth of the first piglet. This NB behaviour included pawing, rooting and arranging nest material. The potential interactions between NB behaviour and postpartum maternal characteristics were investigated. The longest duration of NB behaviour was observed in NEST, followed by PEN and CRATE sows respectively ( $P<0.0001$ ), and this duration tended to be correlated with prepartum OT in sows ( $r_s=0.20$ ,  $P=0.05$ ). Both prepartum OT and PRL concentrations were greater in NEST than in CRATE and PEN sows ( $P<0.05$ ). An interaction existed between OT and PRL concentrations ( $r=0.26$ ,  $P<0.01$ ), and PRL increased as the parturition date approached ( $P<0.0001$ ), whereas prepartum OT did not differ between days. Total duration of prepartum NB behaviour was positively correlated with postpartum carefulness of sows when lying down ( $r_s=0.52$ ,  $P<0.01$ ), and negatively correlated with the average duration of successful nursing bouts in early lactation ( $r_s=-0.42$ ,  $P<0.05$ ). In conclusion, it appears that NB behaviour in prepartum sows could be enhanced by the provision of nesting materials. This, coupled with elevated OT and PRL concentrations, could result in improved postpartum nursing performance and maternal behaviour in early lactating sows.

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## 1. Introduction

Prepartum sows have a robust instinct to build a nest before parturition (Widowski and Curtis, 1990; Wischner

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et al., 2009). Even when kept in barren farrowing environments with no possibility to build a nest, sows perform nest-building (NB) movements (Lawrence et al., 1994; Jarvis et al., 1997). Several studies have discussed that this NB behaviour could be triggered by a rise in prepartum prolactin (PRL) concentrations (Castrén et al., 1993; Algers and Uvnäs-Moberg, 2007), and be activated by environmental factors to reach completion of the nest (Jensen, 1993; Algers and Uvnäs-Moberg, 2007; Wischner et al., 2009). However, the farrowing crate in modern pig husbandry restricts this internal behaviour due to the lack of space, materials or both.

Restriction of NB behaviour could provoke an increase in endogenous opioid receptor density (Zanella et al., 1996; Uvnäs-Moberg and Petersson, 2005), and thus a decrease in circulating plasma OT concentrations in sows (Oliviero et al., 2008; Yun et al., 2013). The release of OT could lead to an increase in circulating PRL concentrations, and play a crucial part in improving maternal characteristics (Pedersen and Prange, 1979; Pedersen et al., 1992; Yun et al., 2013). Furthermore, several studies showed that a suppression of endogenous OT concentrations could negatively affect early lactation performance in sows (Yun et al., 2013, 2014), and could also delay maternal behaviour in the primiparous rat (Pedersen et al., 1992). OT release is widely known to be stimulated by not only the central nervous system, but also by various types of non-noxious senses such as thermal, tactile, or olfactory stimuli (Uvnäs-Moberg and Petersson, 2005).

The aim of the current study was to investigate the influence of provision of abundant nesting materials and space prior to parturition on NB behaviour of prepartum sows, and to study their interactions with circulating OT and PRL concentrations. It was hypothesized that providing nesting materials and space could enhance prepartum NB behaviour, and that vigorous prepartum NB behaviour would result in improved postpartum maternal characteristics, possibly due to elevated circulating OT and PRL concentrations.

## 2. Materials and methods

All experimental procedures performed in this study were approved by the Ethical Committee for Institutional Animal Use and Care of the University of Helsinki. The study was conducted from March to May 2011 at a commercial pig farm registered as an experimental research station in Hyvinkää, southern Finland. Farrowing housing conditions and experimental designs were similar as in a previous study (Yun et al., 2013).

### 2.1. Animals and housing

A total of 35 crossbred sows (Finnish Yorkshire × Finnish Landrace; 12 gilts, 12 parity 2, and 11 parity 3 or 4) were housed in three different farrowing environments for approximately seven days before their expected parturition date. Animals were kept in a temperature-controlled room, where they were allowed *ad libitum* access to water from a nipple drinker, and were fed three times a day (08:30, 14:30 and 19:30 h) via an automatic liquid feeding

system. Each farrowing pen (230 cm × 210 cm) contained conventional steel farrowing crates and wooden piglet shelters situated in one corner with a heat lamp on the concrete floor. Housing and diet conditions were described in more details previously (Yun et al., 2013). All sows included in the experiment farrowed without assistance or induction.

### 2.2. Experimental treatments

Sows were allocated to three treatments according to a randomized complete block design: (1) CRATE: 11 (4 parity 1, 4 parity 2, and 3 parity 3 or 4) sows were kept in a farrowing crate (210 cm × 80 cm) without possibility to turn around, and with a bucketful of sawdust on the floor, (2) PEN: 12 (4 each parity 1, parity 2, and parity 3 or 4) sows were housed in a pen with the farrowing crate opened, and a bucketful of sawdust on the floor, (3) NEST: 12 (4 each parity 1, parity 2, and parity 3 or 4) sows were housed in a pen with the farrowing crate opened, and were provided with two bucketfuls of sawdust, a shredded newspaper, three bucketfuls of chopped straw, seven tree branches, and three natural sisal ropes of 50 cm length. All the nesting materials in the NEST treatment and the bucketful of sawdust in the CRATE and PEN treatments were replaced if they were soiled prior to parturition. All sows were crated without additional supply of NB materials, after the first piglet was born until 7 days after parturition.

### 2.3. Sample collection and assays

All experimental sows were catheterized five days before their expected farrowing date with an indwelling ear vein catheter inserted using a non-surgical catheterization procedure (Virolainen et al., 2005; Yun et al., 2013). Prepartum plasma samples were collected via the indwelling catheter on days -3, -2, and -1 (parturition being day 0), twice a day, approximately 1 h before the morning (08:30 h) and afternoon (14:30 h) feedings. Concentrations of OT were measured with a porcine oxytocin ELISA Kit (Genxio Health Sciences Pvt. Ltd., India). Sensitivity of the plasma OT assay was 2.5 pg/ml. The intra- and inter-assay CVs were 7.6% and 11.5%, respectively. Concentrations of PRL were determined according to a previously described RIA (Robert et al., 1989). The radioinert PRL and the first antibody to PRL were purchased (A.F. Parlow; U.S. National Hormone and Pituitary Program, National Institute of Diabetes and Digestive and Kidney Diseases, Torrance, CA). Validation for a plasma pool from lactating sows was conducted. Parallelism was 94.3% and average mass recovery was 95.7%. Sensitivity of the PRL assay was 1.5 ng/ml. The intra- and inter-assay CVs were 5.7% and 1.2%, respectively.

### 2.4. Behavioural observations

All sows in the experiment were video-recorded from 18 h prior to parturition until birth of the first piglet to assess the display of NB behaviour. Internet protocol (IP) cameras (Niceview NICECAM420WL, Niceview Corp.) were mounted on feed pipes above each pen. The sequence

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