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Lactational oestrus and reproductive performance following a delayed limited nursing schedule in primiparous sows

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ABSTRACT

With conventional lactation management, sows only conceive after weaning. However, intermittent suckling (IS) enables follicle growth and ovulation during lactation by reducing the suckling-induced inhibition of gonadotrophins. The current study evaluated IS regimes initiated at Day 21 or Day 28 post farrowing compared to conventional weaning on Day 28, in primiparous sows. Sows (Large White and Large White x Landrace) were randomly allocated to Control (C28; n = 44), IS21 (n = 29) and IS28 (n = 34) treatments at Day 20. Sows in IS21 and IS28 were subjected to intermittent suckling from Day 21 or Day 28 post farrowing. During IS, sows were separated from their piglets for 8 h daily, then weaned 7 d later at Day 28 and Day 35 respectively, whereas piglets in the C28 treatment had continuous access to sows until weaning at Day 28. Percentage of IS sows that showed oestrus during lactation was 59% (16/27) in IS21 and 72% (21/29) in IS28 ($P > 0.05$). Cumulatively over the lactation and 7 d post-weaning period, 93% of IS21, 85% of IS28 and 93% (31/33) of C28 sows showed oestrus ($P > 0.05$). Pregnancy rate at Day 30 post mating, for sows that were mated during lactation was 93% (15/16) in IS21 and 95% (20/21) in IS28, whereas C28 sows had a 96% (30/31) pregnancy rate ($P > 0.05$). No difference was found in the time of oestrus relative to weaning (C28) or onset of IS (IS21 and IS28) ($P > 0.05$). The IS sows that did not ovulate before weaning all showed oestrus within 7 days from weaning, and the weaning to oestrus interval was similar to control sows ($P > 0.05$). However, for all IS sows (across IS treatments) that showed lactational ovulation, LH secretion pattern at onset of IS was different ($P < 0.05$) from the sows that did not ovulate in lactation. Plasma progesterone concentration tended to be lower in the IS21 treatment ($P < 0.10$) compared to the C28 sows at 4 d after ovulation. The subsequent litter size was not affected by treatments although numerically lower for IS21 ($P > 0.05$). The present study showed that in modern primiparous sows, lactational oestrus can be induced and pregnancy can be maintained at a similar rate and producing comparable subsequent litter sizes to conventionally weaned sows when IS commenced at four weeks post farrowing. However, when IS commences at three weeks post farrowing, this may affect the percentage of sows showing oestrus in lactation and may potentially influence subsequent litter size.

1. Introduction

During lactation, follicular development is inhibited because of suppression of luteinising hormone (LH) secretion by the suckling stimulus of the piglets [1,2]. Therefore, duration of lactation has been reduced to either three or four weeks in conventional pig industry to maximise the number of litters per sow per year. However, this weaning age compromises post weaning piglet performance and welfare, because of reduced feed intake of piglets and increased susceptibility due to post weaning stress and dietary change [3]. An alternative is to subject sows to a limited nursing regime, such as intermittent suckling (IS), which allows lactating

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sows to return to oestrus and to be mated, by separating sows and piglets for a sufficient period each day during late lactation [4,5]. Producers could therefore increase annual number of born litters by reducing non-productive days and without compromising piglet welfare under commercial conditions [6]. In recent studies, Gerritsen et al. [7] and Soede et al. [8] evaluated the use of IS regimes from either the third or fourth week post farrowing in mixed parity sows (parity 1 to 9), and reported that embryo development and pregnancy were not compromised compared to weaned control sows. Although the studies showed that lactational ovulation could be trigged by IS regimes in multiparous sows, the number of responsive sows was variable and may depend on parity and breed, more importantly, the stage of lactation at which IS commences [6,9]. Specifically primiparous sows may show a low oestrous response rate [10] and embryo survival is potentially more affected due to the excessive loss of body reserves during lactation [11–13] compared to multiparous sows. There is a lack of information on the physiological aspects of lactational oestrus and reproductive performance in primiparous sows. Hence, the hypothesis in this study was that delaying the onset of lactational oestrus by one week (initiating IS at Day 28 vs Day 21) could improve reproductive performance in primiparous sows with lactational ovulation. The current study evaluated the effects of stage of lactation when IS regimes were applied, on gonadotrophin secretion, follicle development, and outcome of the subsequent pregnancy.

2. Materials and methods

In ten replicates, a total of 50 Large White and 46 Large White x Landrace sows were used. The experiment was approved by the animal ethics committee of the department of Primary Industries and Resources (Project No: S-2012-7), and was conducted at the Pig and Poultry Production Institute (PPPI), Roseworthy piggery, South Australia.

2.1. Housing, feeding and intermittent suckling

Gilts were placed in an environmentally-controlled room and were housed individually in farrowing crates until the start of treatments. Temperature was computer controlled and adjusted automatically based on the day of lactation, with set temperature decreasing gradually from 24 °C at farrowing to 21 °C 14 d later. During hot periods, ventilation air was cooled by an evaporative cooling system. From farrowing (average body weight 208 ± 1.1 kg; $P > 0.05$), sows were fed 2.5 kg of a standard commercial lactation diet formulated to provide 14.1 DE MJ/kg digestible energy and 16.8% crude protein. The feed allowance was then stepped up by 0.5 kg per day until a maximum allowance of 7.5 kg was reached. Feed was provided two times per day (morning/afternoon) and feed refusals were weighed back and recorded on a daily basis. From weaning to the end of oestrus, all sows received a feed allowance of gestation diet at 3 kg/d (13.2 MJ/kg digestible energy and 15.0% crude protein); the feeding regime during gestation then followed conventional protocols at the piggery. Piglets were provided with extra heating using heating lights. Litter sizes were standardised to 11 piglets by cross-fostering within 2 d post farrowing, and creep feed was provided to IS21 and control piglets from Day 18 and to IS28 piglets from Day 25 post farrowing until weaning.

Sows were assigned to one of three treatments based on genetics and body weight as follows. Control sows were weaned on Day 28 post-farrowing (C28; n = 33) whereas IS sows were subjected to intermittent suckling (IS) from Day 21 (IS21; n = 29) or Day 28 (IS28; n = 34) post farrowing for a period of 7 d, and were then weaned at Day 28 and Day 35 post farrowing, respectively.

For the 8 h daily IS period (8 a.m.–4 p.m.), IS21 and IS28 sows were removed from their farrowing crates and were exposed to fence-line contact with boars in a Detection-Mating-Area for 15–20 min daily in the morning, performing a standard oestrus detection procedure before being moved to individual stalls. Oestrus detection using back-pressure testing was performed during the IS period and after weaning until oestrus ceased. For C28 sows, were moved to individual stalls on the day of weaning and received boar contact daily in the same way as the sows in the other treatments. Sows were artificially inseminated with 3×10^9 spermatozoa from pooled semen at detection of their first standing oestrus and subsequently at 24 h intervals, as long as they showed a standing response. The same procedure was performed for 7 d from the day of weaning for IS sows that had not ovulated during lactation. Separation-to-oestrus and weaning-to-oestrus interval was defined as the time when a sow was detected in heat relative to the start of IS or weaning.

2.2. Measurements, sampling and observations

2.2.1. Body weight, follicle diameter and pregnancy

Sow and piglet body weights (BW) were recorded at one day and three days post farrowing respectively, and at Day 20 and at Day 27 post farrowing. For IS28, sows were weighed again at Day 34 post farrowing in order to compare the BW between IS28 sows and C28 at the end of treatments. Follicle development was monitored using transrectal ultrasound at 5 MHz (Aquila Pro Vet. Esaote Europe B.V., Maastricht, The Netherlands). The average follicle diameter of the three largest follicles from one ovary of each sow was recorded, as described in a previous study [14]. From the first day of separation at Day 21 (IS21), Day 28 (IS28), and also from the day of weaning (C28), scanning was performed once every two days in the morning. Scanning was performed every 12 h (morning/night) once standing oestrus was observed, and continued until ovulation was determined. Ultrasound was performed continuously on IS sows that did not have ovulation during IS for a maximum of 7 d after weaning. Time of ovulation was defined as time of scanning minus 6 h when pre ovulatory follicles were no longer visible. Sows that failed to come into oestrus within 7 d after weaning were classed as anoestrous. Pregnancy was confirmed at four weeks after mating using transcutaneous ultrasonography. The size of the second litters (total born and born alive) was recorded.

2.2.2. Blood sampling for luteinising hormone and progesterone

To determine luteinising hormone (LH) pulsatility, serial blood samples were collected from each treatment on the first day of separation (IS21; n = 7 and IS28; n = 8) or at weaning (C28; n = 7). Post-ovulatory blood samples were collected to evaluate progesterone concentration in all sows. For serial blood sampling, sows were fitted with ear vein catheters immediately after fence-line contact with the boars. Sows were fixed by a snout rope to allow insertion of a 1 × 1.5 mm PVC catheter (Microtube Extrusions, NSW, Australia), 50 cm into a lateral or intermediate auricular vein. The exterior part of the catheter was secured in a pouch at the back of the neck and taped by a Tensoplast-Vet tape (BSN Medical, Australia). Blood samples were then collected from each sow at 12 min intervals, for a period of 8 h. Blood samples were collected in tubes containing 20 μL heparin solution (5000 IU/mL; Heparin Sodium BP, Pfizer Pty Limited, Australia).

Post ovulation plasma progesterone concentration was evaluated by two pre-prandial blood samples that were taken at Day 2 (54 h) and Day 4 (102 h) after estimated ovulation (Day 0). Blood samples were all immediately placed on ice and centrifuged at 1300 g for 20 min at 4 °C, then were stored at −20 °C until analysed.