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Effects of intermittent suckling duration on sow lactation weight loss, hormonal profiles and post-weaning reproductive performance

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Abstract

This study evaluated the effects of different durations of intermittent suckling on weight loss, reproductive hormone profiles, and post-weaning reproductive performance of sows. Sixteen lactating Large White × Landrace sows were randomly allotted to four treatments using a Completely Randomized Design, with four replicates in each treatment. The treatments included continuous suckling (T1), separation of piglets for 4 h/day (T2), 8 h/day (T3), and 12 h/day (T4) for 14 days during the fifth and sixth weeks of lactation. Data collected included feed intake, body weight changes, serum oestrogen, luteinising hormone (LH), follicle-stimulating hormone (FSH) concentrations, and reproductive performance parameters. Data obtained were analysed using descriptive statistics and one-way ANOVA. Average weight loss was significantly (P<0.05) reduced in T3 (-3.58±0.51 kg) and T4 (-3.21±0.60 kg) compared with T1 (-5.07±0.70 kg) and T2 (-4.86±0.46 kg). Sows subjected to longer separation periods showed earlier peaks of LH, FSH, and oestrogen concentrations, suggesting earlier resumption of ovarian activity. Weaning-to-oestrus interval was significantly (P<0.05) shorter in T3 (4.00±0.71 days) and T4 (4.00±0.00 days) than in T1 (7.00±1.00 days) and T2 (6.00±0.71 days). In conclusion, intermittent suckling for 8–12 hours daily reduced lactational weight loss and shortened the weaning-to-oestrus interval without compromising subsequent reproductive performance.

Keywords: *Intermittent suckling, lactating sows, sow productivity, weight loss*

Efficient reproductive performance of sows is key for profitable pig farming, since it influences the number of piglets each sow produces yearly and boosts the herd's overall productivity (Argana et al., 2025). During lactation, sows face a physiologically demanding period that typically leads to a negative energy balance because feed intake may not adequately meet the nutritional requirements for maintenance and milk production. Consequently, sows mobilize body reserves, resulting in lactational weight loss, which may adversely influence subsequent reproductive performance (Foxcroft, 1992; Thaker and Bilkei, 2005). Studies show that excessive body weight loss may lead to prolonged weaning-to-oestrus intervals and reduced reproductive efficiency (Vesseur et al., 1994; Hu et al., 2019).

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Conventionally, piglets are usually weaned from their dams at 3–4 weeks of age (Kuller et al., 2004; Marchant-Forde et al., 2020). Although this can improve sow productivity by reducing the interval between farrowing and subsequent conception, early weaning may expose piglets to stress and adversely affect their growth and welfare (Moeser et al., 2019). However, intermittent suckling has been developed as an alternative weaning strategy to address these challenges. Intermittent suckling involves the daily separation of piglets from their dam for a specified period during late lactation before complete weaning (Turpin et al., 2016; Cheng et al., 2023).

The practice reduces suckling intensity and milk demand, lessening the metabolic stress on the sow and minimising body reserve use during lactation (Kuller et al., 2004). The reduction in milk production resulting from temporary separation may consequently reduce sow weight loss and enhance the recovery of body condition after weaning. Furthermore, improved body condition has been linked to shorter intervals of weaning-to-oestrus and improved reproductive performance (Brown et al., 2016). However, the optimal duration of intermittent suckling required to achieve these benefits has not been clearly established. Hence, this study was conducted to evaluate the effects of different durations of intermittent suckling on weight loss and reproductive performance of sows.

Materials and methods

The procedures employed in this study which was conducted at the Piggery Unit of the Teaching and Research Farm, University of Ibadan, Ibadan, Nigeria, were in accordance with the ARRIVE guidelines for animal research. In addition, all experimental procedures complied with the U.K. Animals (Scientific Procedures) Act 1986 and associated guidelines, the EU Directive 2010/63/EU for animal experiments, and the National Institutes of Health Guide for the Care and Use of Laboratory Animals (NIH Publications No. 8023, revised 1978). The laboratory analyses of blood samples were conducted at the Animal Physiology Laboratory, Department of Animal Science, University of Ibadan.

Sixteen first-parity lactating Large White × Landrace sows were used for the study. Litter size varied among sows; therefore, four piglets were selected from each litter to standardise the number of suckling piglets per sow across treatments. The sows and their selected piglets were randomly allocated to four treatment groups in a completely randomised design, with four replicates per treatment. The treatments consisted of continuous suckling (0 h separation) and daily separation of piglets from the sow for 4, 8, and 12 hours. The separation programme started on the first day of the fifth week of lactation and continued for 14 consecutive days. Lactation lasted six weeks, after which reproductive performance was monitored through oestrus detection, mating, conception, and subsequent farrowing. The experiment lasted 25 weeks. Data collection commenced immediately after farrowing, and the newly farrowed sows were assigned to treatments and replicates. The parameters measured included growth performance, reproductive indices and reproductive hormone profiles of the sows.

Lactating sows were offered feed twice daily at 08:00 and 14:00 hours. The quantity of feed offered to each replicate was weighed before feeding, and the leftovers were also weighed using a Camry tabletop weighing scale. Feed intake was determined by subtracting the amount of feed refusal from the amount offered.

The body weight of the lactating sows per replicate was recorded at the commencement of the experiment using a weighing scale, and subsequently on a weekly basis until weaning. At the termination of the experiment, weight change was determined as the difference between final body weight and initial body weight.

Blood (5 mL per sample) was collected from each lactating sow through the anterior vena cava on the first day of intermittent suckling and subsequently at approximately three-day intervals until oestrus was detected after weaning. Sampling was conducted on Days 1, 4, 7, 11, 14, 17, 21 and 24, representing approximately three-day sampling intervals. Serum oestrogen, luteinising hormone and follicle stimulating hormone levels were assayed using ELISA kits, following the manufacturers' instructions. Reproductive parameters assessed included litter size, number of piglets born alive, litter birth weight, number of still births, weaning-to-oestrus interval and percentage conception.

Data on growth and reproductive performance were analysed using one-way analysis of variance (ANOVA) in SAS (Version 9.4). Treatment means were separated using Duncan's Multiple Range Test where significant differences occurred ($P<0.05$). Hormonal profiles were analysed using descriptive statistics.

Results and discussion

Table 1 presents the growth performance of lactating sows exposed to varying durations of separation from their piglets. No significant differences ($P>0.05$) were observed among treatments for initial body weight, which varied between 63.67±1.89 kg (T2) to 60.33±1.41 kg (T4), average feed intake, which varied between 30.67±2.28 kg (T1) to 28.92±2.02 kg (T3), and final weight, which varied between 58.81±2.96 kg (T2) to 57.12±3.30 kg (T4). In contrast, average weight loss differed significantly ($P<0.05$) among treatments with sows in T1 (-5.07±0.70 kg) and T2 (-4.86±0.46 kg) showing significantly higher weight loss than those in T3 (-3.58±0.51 kg) and T4 (-3.21±0.60 kg). The lower weight loss observed in sows subjected to 8 and 12 hours of daily separation may be attributed to reduced suckling intensity and milk production demand. Lactating

Table 1. Growth performance of lactating sows subjected to varying durations of separation from the piglets

	Hours of separation			
Parameters (kg)	T1 (0 hours)	T2 (4 hours)	T3 (8 hours)	T4 (12 hours)
Initial weight	63.00±3.35	63.67±1.89	61.00±2.55	60.33±1.41
Final weight	57.93±4.21	58.81±2.96	57.42±3.18	57.12±3.30
Average weight loss	-5.07±0.70[a]	-4.86±0.46[a]	-3.58±0.51[b]	-3.21±0.60[b]
Average feed intake	30.67±2.28	29.67±2.36	28.92±2.02	29.06±2.47

[a,b] Means within the same row bearing different superscripts differ significantly (*P<0.05*)

sows are often in a catabolic state and experience body weight loss because their feed intake is often insufficient to meet the nutritional demands of milk production. Consequently, body reserves are mobilised to support lactation, resulting in weight loss. However, the separation periods applied in this study decreased suckling by piglets, consequently reducing milk production and minimising loss of weight in the sows. Previous studies have shown that sows subjected to intermittent suckling experience lower body weight loss than those subjected to continuous suckling (Kuller et al., 2004; Turpin et al., 2016).

Figure 1 illustrates the concentration of luteinising hormone in sows from the intermittent suckling period through to the onset of oestrus. A progressive increase in LH concentration was observed in all treatments, followed by a marked surge that indicated peak hormonal activity. In T1, LH increased from 1.24±0.03 ng/ml (day 1) to a peak of 7.48±0.15 ng/ml (day 24). In T2, LH rose from 1.68±0.05 ng/ml to 7.83±0.24 ng/ml (day 21). Similarly, LH in T3 increased from 1.37±0.12 ng/ml to 8.01±0.26 ng/ml (day 21), while LH in T4 rose from 1.29±0.07 ng/ml to 8.05±0.31 ng/ml (day 17). Figure 2 shows the concentration of FSH (ng/ml) in sows during the same period. A progressive increase followed by a sharp peak was observed in all treatments. In T1, FSH increased from 1.37±0.14 ng/ml (day 1) to 5.13±0.21 ng/ml (day 24). In T2, it rose from 1.85±0.04 ng/ml to 5.28±0.34 ng/ml (day 21). In T3, it increased from 1.39±0.18 ng/ml to 5.84±0.26 ng/ml (day 21), while in T4, it increased from 1.63±0.09 ng/ml to 5.71±0.52 ng/ml on day 17. Thus, T4 exhibited the earliest LH and FSH peaks, together with the highest LH peak and the second-highest FSH peak. Figure 3 shows the concentration of oestrogen (pg/ml) in sows from the onset of intermittent suckling through to onset of oestrus. In T1, oestrogen increased from 25.36±2.78 pg/ml (day 1) to 136.75±4.38 pg/ml (day 21). In T2, it rose from 25.85±1.94 pg/ml to 127.64±4.26 pg/ml (day 17). In T3, it increased from 30.07±2.19 pg/ml to 133.74±3.58 pg/ml (day 17), while in T4, it increased from 20.50±1.64 pg/ml to 81.51±3.17 pg/ml (day 17). Notably, despite having the earliest and highest LH peak and an early, relatively high FSH peak, T4 had the lowest oestrogen peak among the treatment groups. This suggests that

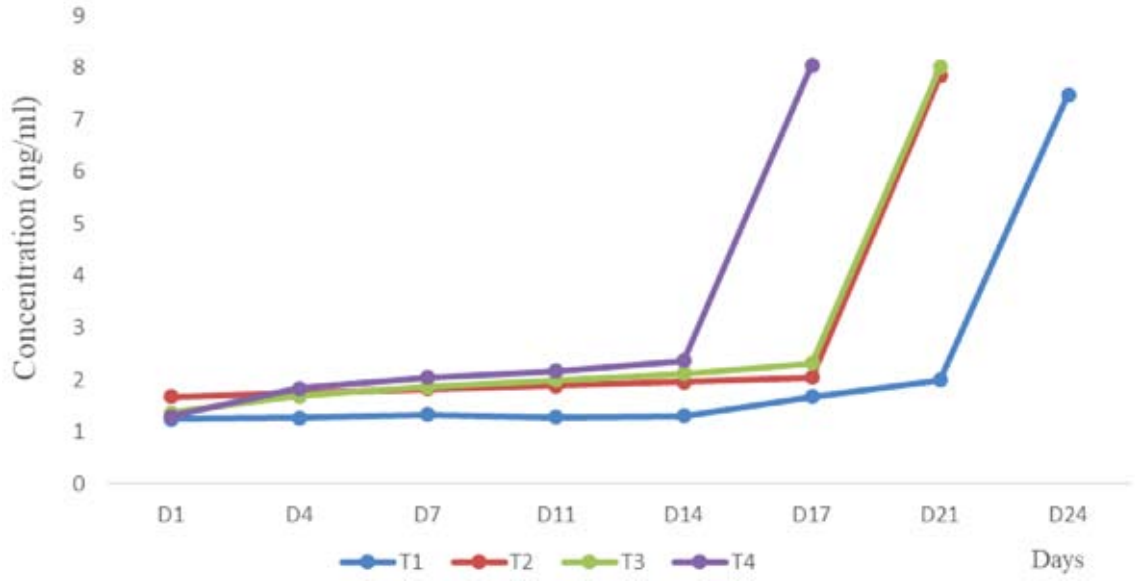


Fig. 1. Concentration of luteinising hormone (ng/ml) in sows from the onset of intermittent suckling to the onset of oestrus

Treatment 1: Continuous suckling (0 hours); Treatment 2: Separation for 4 hours Treatment 3: Separation for 8 hours; Treatment 4: Separation for 12 hours

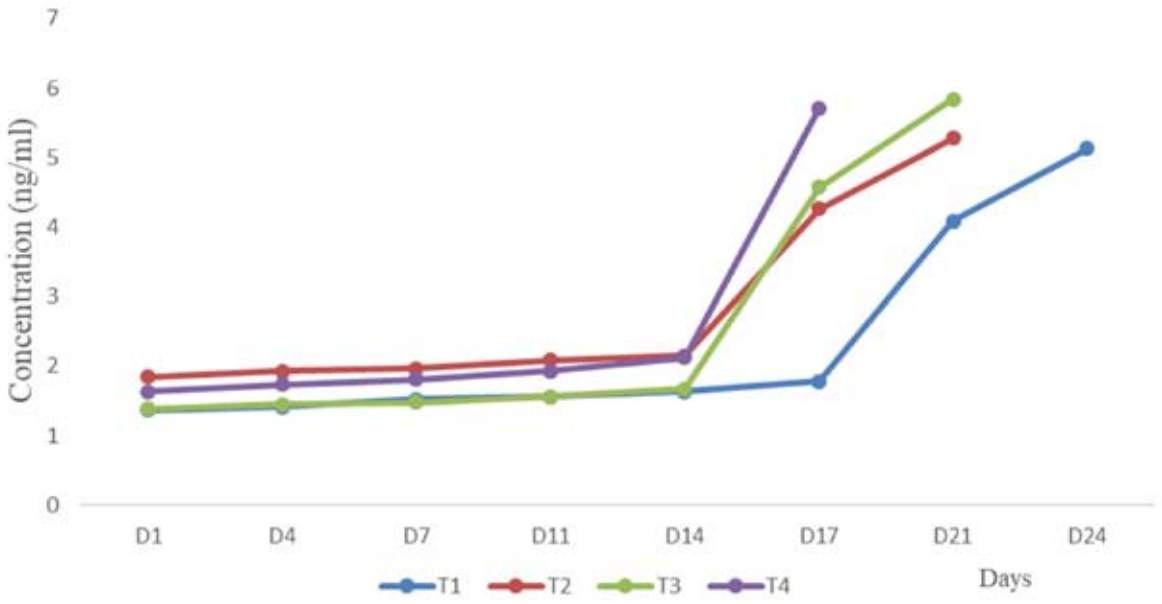


Fig. 2. Concentration of follicle stimulating hormone (ng/ml) in sows from the onset of intermittent suckling to the onset of oestrus

Treatment 1: Continuous suckling (0 hours); Treatment 2: Separation for 4 hours, Treatment 3: Separation for 8 hours; Treatment 4: Separation for 12 hours

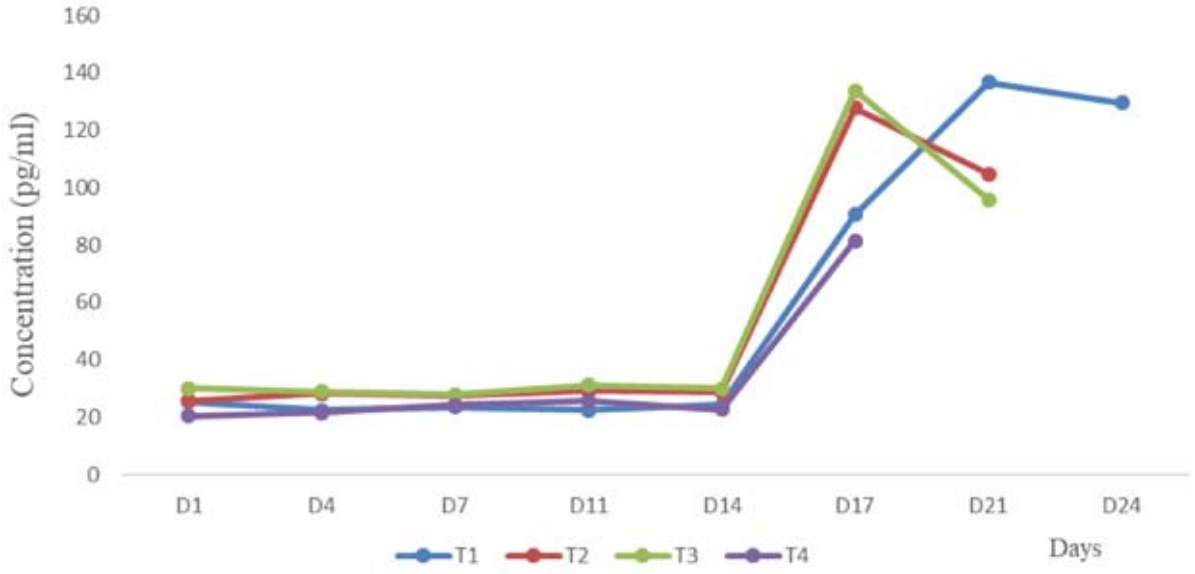


Fig. 3. Concentration of oestrogen (pg/ml) in sows from the onset of intermittent suckling to the onset of oestrus

Treatment 1: Continuous suckling (0 hours); Treatment 2: Separation for 4 hours, Treatment 3: Separation for 8 hours; Treatment 4: Separation for 12 hours

the magnitude and timing of the gonadotrophin response were not directly proportional to the oestrogen response. The earlier gonadotrophin response in T4 may have reflected more rapid reactivation of the hypothalamic–pituitary–ovarian axis, whereas the comparatively lower oestrogen concentration may be related to differences in the timing and extent of follicular development or ovarian steroidogenic activity. However, because follicular characteristics and ovarian steroidogenic activity were not measured in the present study, this interpretation remains tentative.

Lactating sows are typically in a state of lactational anoestrus due to the inhibitory effect of suckling on hypothalamic secretion of GnRH. However, each period of piglet separation from the sow triggers a positive feedback response at the hypothalamus, leading to the release of GnRH. GnRH subsequently stimulates the release of the gonadotrophins (luteinising hormone (LH) and follicle-stimulating hormone (FSH)) from the anterior pituitary gland (Langendijk et al., 2007; Quesnel, 2009). However, when piglets are returned to the sow, suckling temporarily inhibits further LH and FSH secretion, although circulating levels

Table 2. Post-weaning reproductive performance of sows subjected to intermittent suckling

	Hours of separation			
Parameters	T1 (0 hours)	T2 (4 hours)	T3 (8 hours)	T4 (12 hours)
Weaning-to-oestrus interval (days)	7.00±1.00[a]	6.00±0.71[a]	4.00±0.71[b]	4.00±0.00[b]
Percentage conception (%)	100.00	100.00	100.00	100.00
Average litter size	7.00±1.22	7.00±0.71	7.00±0.71	8.00±1.00
Number of piglets born alive	7.00±1.22	7.00±0.71	7.00±0.71	8.00±1.00
Number of stillbirths	0.00±0.00	0.00±0.00	0.00±0.00	0.00±0.00
Average litter birth weight (kg)	1.40±0.16	1.37±0.23	1.44±0.12	1.41±0.28

[a, b] Means within the same row bearing different superscripts differ significantly (*P<0.05*)

of these hormones remain present in the bloodstream. With repeated separation, hormone concentrations progressively increase, potentially triggering ovarian activity, follicular development, and oestrogen secretion, thereby shortening the time required to reach peak hormonal activity and reducing the interval of weaning-to-oestrus. In this study, increased duration of separation was associated with a progressive rise in LH concentration and a shorter weaning-to-oestrus interval. LH and FSH play a key role in initiating follicular development and maturation during the post-weaning period. As follicles develop, ovarian steroidogenesis increases, resulting in elevated circulating oestrogen concentrations. Once oestrogen reaches a critical threshold, it induces the pre-ovulatory LH surge at oestrus, after which oestrogen levels begin to decline (Langendijk et al., 2007; Quesnel, 2009). The T4 results suggest, however, that an earlier or greater gonadotrophin response does not necessarily result in the highest oestrogen concentration, suggesting that the ovarian response may also depend on the timing and extent of follicular development and steroidogenic activity.

Table 2 presents the post-weaning reproductive performance of sows subjected to intermittent suckling. No significant differences (*P>0.05*) were observed among the treatments for the percentage conception which was 100.00 % across all treatments, average litter size and number of piglets born alive which ranged from 8.00±1.00 (T4) to 7.00±1.22 (T1), number of still births which was 0.00 for all the treatments, and average litter birth weight which varied between 1.44±0.12 kg (T3) and 1.37±0.23 kg (T2). However, a significant difference (*P<0.05*) was recorded in the weaning-to-oestrus interval. Sows in T1 (7.00±1.00 days) and T2 (6.00±0.71 days) had significantly longer (*P<0.05*) weaning-to-oestrus interval compared with those in T3 (4.00±0.71 days) and T4 (4.00±0.00 days).

Intermittent suckling is considered beneficial only when it does not adversely affect sow reproductive performance; hence, this study evaluated its effects on sow reproductive performance. A sow's body condition influences how early it returns to oestrus post-weaning, as greater weight loss during the period of lactation is generally associated with a longer interval to oestrus, while improved body condition shortens this period. This was evident in the present study where sows in T1 returned to oestrus after approximately 7 days compared with 4 days in sows in T4. The shorter weaning-to-oestrus interval observed in intermittently suckled sows may be attributed to reduced suckling intensity, lower milk production demand, and reduced mobilisation of body reserves, thereby reducing the metabolic burden associated with lactation. Furthermore, sow reproductive performance is largely influenced by metabolic condition and the suckling stimulus from piglets (Quesnel, 2009). During the period of lactation, sows often experience a catabolic state, which may negatively affect post-weaning reproductive performance (Thaker and Bilkei, 2005; Hu et al., 2019). Previous studies have also reported a shorter weaning-to-oestrus interval in sows subjected to intermittent suckling (Brown et al., 2016).

Conclusion

Intermittent suckling improved the post-weaning reproductive response of sows by reducing lactational weight loss and suggesting an earlier resumption of ovarian activity. Sows subjected to 8–12 hours of daily separation showed reduced weight loss and a significantly shorter weaning-to-oestrus interval compared with continuous and 4-hour separation groups. These findings suggest that extended intermittent suckling may enhance endocrine recovery and shorten the post-weaning reproductive delay in sows.

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Conflict of interest

The authors declare that there is no conflict of interest in this work.

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