Influence of normal and limited suckling on body weight performance and postpartum ovarian activity in swamp buffaloes
(Pengaruh penyusuan biasa dan terhad terhadap prestasi berat badan dan pemulaan aktiviti ovari selepas kelahiran pada kerbau sawah)

Y. Nordin* and M. R. Jainudeen**

Key words: swamp buffalo, suckling frequency, body weight, body condition, postpartum ovarian activity

Abstract
The influence of normal and limited suckling on body weight, body condition score (BCS) and resumption of ovarian activity was investigated in 36 swamp buffaloes from day 31 to day 150 postpartum. The treatments were normal suckling (S), restricted suckling (RS) and early weaning (EW). S calves remained with dams throughout the experimental period while RS calves were allowed to suckle once daily in the morning for 20–25 min and separated from the dam after suckling. EW calves were weaned from the dams at 30 days old. The postpartum interval to first ovulation was significantly higher ($p < 0.05$) in S (91 days) as compared with RS (67 days) or EW (43 days). Only 8.3% of the S animals resumed ovarian activity before day 60 postpartum as compared with 41.7% in RS and 91.7% in EW. Animals under EW and RS regained body weight and

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Effects of suckling frequency on the performance of swamp buffaloes

BCS beginning week 6 postpartum, whereas the S animals continued losing body weight and BCS until week 14 postpartum. It is concluded that normal suckling delays while restricted suckling and early weaning enhance the resumption of postpartum ovarian activity of swamp buffaloes. The study also indicates that suckling frequency affects postpartum body weight and body condition.

Introduction
Suckling is one of the most important factors influencing the resumption of postpartum ovarian activity in many farm animals. Previous study (Jainudeen et al. 1983) has demonstrated that suckling significantly increases the interval from parturition to first oestrus and ovulation in swamp buffaloes. In beef cattle, suckling also affects postpartum ovarian function by lengthening the interval from calving to first oestrus (Short et al. 1972; Bellows et al. 1974; Carter et al. 1980). Normal suckling or increasing the sucking intensity and frequency increases the postpartum anoestrus interval while restricted sucking or early weaning shortens the interval (Wettermann et al. 1978; Randel 1981; Suzuki and Sato 1983; Williams 1990). Suckling affects postpartum ovarian activity via the hypothalamo-pituitary-ovarian axis (Short et al. 1990; Williams 1990). Whether the effects are associated with body weight and body condition loss due to the nutrient drain from the dam to the calf through suckling is not certain. It is hypothesised that if suckling is restricted or totally eliminated then less or no nutrients will be drained, thus, minimising body weight and body condition loss, hence, facilitating earlier resumption of postpartum ovarian activity.

The objectives of this study were (a) to evaluate the effect of sucking frequency on the resumption of postpartum ovarian activity, and (b) to determine the effects of sucking frequency on body weight and body condition changes and their relationship with the resumption of postpartum ovarian activity of swamp buffaloes.

Materials and methods
Animals and management
Twenty-three pluriparous and 13 primiparous pregnant swamp buffaloes (Bubalus bubalis) were used in the study. The animals were grazed in open pasture of Brachiaria decumbens during their pregnancy period. Six to eight weeks prior to calving, they were housed in individual pens. Each animal was fed with cut Panicum maximum (30% DM, 8.3% CP) given ad libitum and supplemented with concentrate (91% DM, 14% CP) given at 1% body weight. The animals had free access to drinking water and salt licks. The same feeding regime was continued after calving until the end of the 150-day experimental period.

Suckling treatment
All calves suckled their dams from birth until day 30. Between day 31 and day 150 postpartum, the 36 swamp buffaloes were allocated by parity and randomly assigned to one of the three sucking treatments: suckling (S), restricted suckling (RS) and early weaning (EW). Calves in the S group remained with their dams throughout the experimental period, those in RS group sucked their dams once daily in the morning for 20–25 min then separated until the next day while those in EW group were weaned at 31 days of age.

Body weighing and body condition scoring
Within 36 h after calving, body weight and body condition score were recorded. Body condition was scored using a scale of 1 to 9 (1= emaciated, 2 = poor, 3 = thin, 4 = borderline, 5 = moderate, 6 = high moderate, 7 = good, 8 = fat and 9 = extremely fat) by examining the area around
the tail, backbone, hips, pin bones, ribs and transverse-process of lumbar vertebrae. Subsequent weighing and body condition scoring were done biweekly.

**Oestrus detection**
Buffaloes were observed for oestrus daily during 8.00–9.00 a.m. and 5.00–6.00 p.m. using a fertile bull. Standing to be mounted (standing oestrus) either by the bull or by other females was used as the criterion for oestrus.

**Blood sampling and progesterone assay**
Blood samples from the jugular vein were collected into evacuated tubes containing EDTA at 3 to 4-day intervals beginning from day 15 to day 150 postpartum. Separated blood plasma was stored at –20 °C until assayed for progesterone level by a solid-phase radioimmunoassay (RIA) technique using progesterone-RIA kit supplied by the FAO/IAEA. The intra-assay coefficient of variation was 6.25% (n = 10) for the low plasma pool and 4.09% (n = 8) for the high plasma pool. The inter-assay coefficient of variation was 14.6% (n = 5) for the low pool and 10.78% (n = 5) for the high pool. The sensitivity of the assay was 0.03 ng/mL. According to the manufacturer of the kit (Diagnostic Products Corporation, California), the cross-reactivity of the progesterone-antiserum with progesterone in a plasma sample was 100%.

**Postpartum ovarian activity**
Resumption of ovarian activity was determined from the progesterone profiles. The first increase of plasma progesterone level of 0.7 ng/mL or higher sustained for two or more successive samplings was used as the criterion for resumption of postpartum ovarian activity (Jainudeen et al. 1983). Day of ovulation was estimated by subtracting 3 days from the day of first progesterone level greater than 0.7 ng/mL. Based on progesterone profiles, the animals were classified into categories (Table 1).

<table>
<thead>
<tr>
<th>Duration to resumption of ovarian activity (days postpartum)</th>
<th>Type of ovarian activity</th>
</tr>
</thead>
<tbody>
<tr>
<td>Less than 60 days</td>
<td>Early cyclicity</td>
</tr>
<tr>
<td>61–100</td>
<td>Normal cyclicity</td>
</tr>
<tr>
<td>101–150</td>
<td>Delayed cyclicity</td>
</tr>
<tr>
<td>No ovarian activity during the first 150 days postpartum</td>
<td>Anoestrus</td>
</tr>
</tbody>
</table>

**Analysis of data**
The experiment was a completely random design with normal and limited suckling and early weaning as the treatments. Data on body weight were analysed by analysis of covariance using body weight at calving as covariates. The experimental data were analysed by Statistical Analytical System (SAS) using Generalised Linear Model (GLM) procedure.

Data on body condition score and postpartum intervals were analysed by SAS procedure for GLM. Treatment means were compared using Duncan’s test. Discrete variables were analysed by Chi-square test. Correlation analysis was performed to determine the relationship between body weight change and body condition score with postpartum intervals to first ovulation and to first oestrus. Body weight change and body condition score were used as independent variables, and the postpartum intervals were used as dependent variables. Percentage of change in postpartum body weight was calculated as follows: \( \frac{(BWx - BWo)}{BWo} \times 100 \), where \( BWx \) is body weight at \( x \) week postpartum and \( BWo \) is body weight at calving.

**Results**

**Body weight and body condition score**
The postpartum body weights of the swamp buffaloes are shown in Figure 1. The least square means and the standard error of the adjusted body weight are shown in Table 2. Body weights of buffaloes decreased from calving to week 6 postpartum in all groups,
Effects of suckling frequency on the performance of swamp buffaloes

then increased in RS and EW groups. However, buffaloes in the S group continued to lose body weight until week 14 postpartum before starting to gain body weight. The body weight of the three suckling groups after calving to week 16 postpartum could be predicted from the following regression equations:

\[ y = 466.42 - 4.00x + 0.16x^2 \ (r^2 = 0.72, \ p <0.05) \] for S group;

\[ y = 472.65 - 5.23x + 0.24x^2 \ (r^2 = 0.94, \ p <0.01) \] for RS group and

\[ y = 475.76 - 3.86x + 0.24x^2 \ (r^2 = 0.79, \ p <0.01) \] for EW group where

\( y = \) postpartum body weight and \( x = \) week postpartum. There were no significant differences (\( p >0.05) \) in the body weights among the treatment groups at various postpartum interval (Table 2) except at week 14 in which the body weights of S group were significantly lower (\( p <0.05) \) than EW group but there were no differences in the body weights between the RS and EW groups.

Trend in the changes of body weight of the animals is shown in Figure 2. The percentages of body weight loss in the three groups were more or less similar from calving till week 4 postpartum, the values being –4.41, –3.88 and –3.84% for S, RS

\[ Body weight (kg) \]

\[ Weeks postpartum \]

\[ Normal suckling \]  \[ Restricted suckling \]  \[ Early weaning \]

<table>
<thead>
<tr>
<th>Weeks postpartum</th>
<th>Normal suckling</th>
<th>Restricted suckling</th>
<th>Early weaning</th>
</tr>
</thead>
<tbody>
<tr>
<td>2</td>
<td>448.7 ± 6.0</td>
<td>463.7 ± 6.0</td>
<td>463.1 ± 6.0</td>
</tr>
<tr>
<td>4</td>
<td>455.0 ± 3.8</td>
<td>457.7 ± 3.8</td>
<td>457.9 ± 3.8</td>
</tr>
<tr>
<td>6</td>
<td>450.4 ± 5.7</td>
<td>446.5 ± 5.7</td>
<td>454.4 ± 5.7</td>
</tr>
<tr>
<td>8</td>
<td>450.0 ± 7.0</td>
<td>447.9 ± 7.0</td>
<td>459.7 ± 7.0</td>
</tr>
<tr>
<td>10</td>
<td>447.9 ± 8.4</td>
<td>451.5 ± 8.4</td>
<td>456.4 ± 8.4</td>
</tr>
<tr>
<td>12</td>
<td>444.3 ± 7.5</td>
<td>447.7 ± 7.5</td>
<td>461.2 ± 7.5</td>
</tr>
<tr>
<td>14</td>
<td>441.6b± 7.5</td>
<td>447.9ab ± 7.5</td>
<td>467.8a ± 7.5</td>
</tr>
<tr>
<td>16</td>
<td>448.6 ± 7.5</td>
<td>451.0 ± 7.5</td>
<td>468.8 ± 7.5</td>
</tr>
</tbody>
</table>

Values with different letters within the same row are significantly different (\( p <0.05) \)

Figure 1. Effect of suckling treatments on postpartum body weight of swamp buffaloes

Table 2. Least square mean (± S.E) body weight of postpartum swamp buffalo under three suckling treatments
and EW respectively. From week 6 to week 12 postpartum, percentage of body weight loss was lower in EW than in RS or S group but the difference was not significant. From week 14 to week 16 postpartum, the loss in body weight was significantly higher ($p < 0.05$) in S and RS than in EW. The percentages in loss of body weight by week 16 postpartum were $-6.29$, $-5.36$ and $-1.53\%$ for the S, RS and EW groups respectively.

Body condition declined from calving until week 6 postpartum in EW and RS groups but continued declining until 12 weeks in S group (Figure 3). The body condition scores among the treatment groups at calving to week 8 postpartum were not significantly different but from 10 to 16 weeks postpartum the body condition scores were significantly lower ($p <0.05$) for buffaloes in S than EW and RS groups.

Resumption of postpartum ovarian activity

The progesterone profiles of the buffaloes indicative of cyclicity (early, normal and delayed) and anoestrus are shown in Figure 4. In cycling animals, the progesterone concentration at oestrus was less than 0.3 ng/mL and during luteal phase ranged from 0.7 to 4.5 ng/mL. In anoestrous buffaloes, the plasma progesterone level remained below 0.3 ng/mL throughout the experimental period.
Effects of suckling frequency on the performance of swamp buffaloes

There was no effect of suckling treatments on the oestrous cycle lengths (Table 3). The mean cycle lengths were 22.5, 22.6 and 19.8 days in the S, RS and EW groups respectively, and the overall mean cycle length was 21.3 days. Normal cycle lengths (18–24 days) occurred in 83, 74 and 84% of the cycles in the S, RS and EW groups respectively while the occurrence of short cycles (< 17 days) were respectively 0, 4.3 and 12.0%. Long oestrous cycle length (> 25 days) made up the remaining percentages.

The postpartum interval to first ovulation was significantly longer (p < 0.05) in the S than EW and RS groups (Table 4) while the calving to first oestrus and conception intervals were significantly shorter (p < 0.05) in the EW than S groups.

The percentage of animals with early cyclicity was significantly higher (p < 0.05) in the EW (91.7%) than RS (41.7%) or S (8.3%) groups (Figure 5), and normal cyclicity was observed in 41.7, 50.0 and 0% of the S, RS and EW groups respectively. The percentage of animals with delayed cyclicity was 8.3 in the EW and 25.0 in the S group. By the end of the experimental period, animals resuming ovarian cyclicity were 75.0, 91.7 and 100% for S, RS and EW groups respectively.

**Figure 4. Postpartum progesterone profiles of swamp buffaloes indicative of early, normal and delayed resumption of ovarian activity and anoestrus**

The correlation between body weight change and body condition score with postpartum interval

The correlation between body weight loss and the postpartum intervals in all the groups was positive but not significant (p >0.05) (Table 5). The correlation between body condition score and the postpartum intervals in the RS and EW groups was negative but not significant (p >0.05) while in the S group the correlation was significant (p <0.05).
Table 3. Occurrence of short, normal and long oestrous cycle lengths in swamp buffaloes under three suckling treatments

<table>
<thead>
<tr>
<th>Suckling treatment</th>
<th>No. of occurrences</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Short cycle (&lt; 17 days)</td>
</tr>
<tr>
<td>Suckling</td>
<td></td>
</tr>
<tr>
<td>Normal</td>
<td>–</td>
</tr>
<tr>
<td>Restricted</td>
<td>1 (4.3)</td>
</tr>
<tr>
<td>Early weaning</td>
<td>3 (12.0)</td>
</tr>
<tr>
<td>Total</td>
<td>4 (7.4)</td>
</tr>
</tbody>
</table>

( ) = percentage of occurrence

Table 4. Effect of suckling treatments on postpartum intervals of swamp buffaloes

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Suckling treatments</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Normal suckling</td>
</tr>
<tr>
<td>Calving to first ovulation (days)</td>
<td>91a ± 25 (9)</td>
</tr>
<tr>
<td>Calving to first oestrus (days)</td>
<td>91a ± 27 (8)</td>
</tr>
<tr>
<td>Calving to conception (days)</td>
<td>92a ± 16 (7)</td>
</tr>
</tbody>
</table>

( ) = no of animals
Mean values with different letters in the same row are significantly different (p < 0.05)

Discussion

There was a marked difference in the time of onset of cyclic postpartum ovarian activity between the S and the EW buffaloes (Table 4). The former group had a calving-to-first-ovulation interval of 94 days as compared with 47 days in the latter group. The 94-day interval in the suckled group was similar to that reported earlier in suckled swamp buffaloes (Jainudeen et al. 1983). The postpartum interval to first observed oestrus and to first elevation of plasma progesterone greater than 0.7 ng/mL reported in the study by Jainudeen et al. (1983) was 88 and 96 days respectively. However, the percentage of suckled animals in anoestrus during the first 150 days postpartum observed in that study (Jainudeen et al. 1983) was substantially higher (68%, 26/38 animals) than that observed in the present work. The marked difference in the percentage could be attributed to differences in management practices of the experimental animals. The animals in that study were managed in paddocks for free grazing, whereas the experimental animals in this study were kept in sheds under intensive management. This suggests that the problem of anoestrus in postpartum swamp buffaloes could be reduced or minimised through improved management.
Effects of suckling frequency on the performance of swamp buffaloes

Table 5. Correlation coefficients for body weight change and body condition score with postpartum intervals to first ovulation and to first observed oestrus of swamp buffaloes under three suckling treatments at different weeks postpartum

<table>
<thead>
<tr>
<th>Suckling regime</th>
<th>Weeks postpartum</th>
<th>Body weight change</th>
<th>Body condition score</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>PPO</td>
<td>PPE</td>
</tr>
<tr>
<td>Normal suckling</td>
<td>4</td>
<td>0.14ns</td>
<td>0.23ns</td>
</tr>
<tr>
<td></td>
<td>8</td>
<td>0.19ns</td>
<td>0.28ns</td>
</tr>
<tr>
<td></td>
<td>12</td>
<td>0.20ns</td>
<td>0.33ns</td>
</tr>
<tr>
<td></td>
<td>16</td>
<td>0.11ns</td>
<td>0.02ns</td>
</tr>
<tr>
<td>Restricted suckling</td>
<td>4</td>
<td>0.02ns</td>
<td>0.01ns</td>
</tr>
<tr>
<td></td>
<td>8</td>
<td>0.09ns</td>
<td>0.03ns</td>
</tr>
<tr>
<td></td>
<td>12</td>
<td>0.51ns</td>
<td>0.37ns</td>
</tr>
<tr>
<td></td>
<td>16</td>
<td>0.17ns</td>
<td>0.34ns</td>
</tr>
<tr>
<td>Early weaning</td>
<td>4</td>
<td>0.23ns</td>
<td>0.24ns</td>
</tr>
<tr>
<td></td>
<td>8</td>
<td>0.09ns</td>
<td>0.04ns</td>
</tr>
<tr>
<td></td>
<td>12</td>
<td>0.09ns</td>
<td>0.00</td>
</tr>
<tr>
<td></td>
<td>16</td>
<td>0.00ns</td>
<td>0.11ns</td>
</tr>
</tbody>
</table>

ns = not significant at $p < 0.05$; * significant at $p < 0.05$

PPO = postpartum intervals to first ovulation
PPE = postpartum intervals to first observed oestrus

The shorter postpartum interval to first ovulation in the RS (67 days) than in the S group indicates that restricted suckling also induced earlier resumption of ovarian cyclicity although its effect was not as pronounced as early weaning. In the Thai swamp buffaloes, restricted suckling twice daily also enhanced early reestablishment of postpartum ovarian activity as compared with buffaloes on normal suckling (Wongsrikeao et al. 1990). Decreased calving-to-first ovulation interval (42 days) in swamp buffaloes weaned at birth had also been reported (Jainudeen et al. 1984). Early weaning in swamp buffaloes shortened the calving to conception interval as in beef cattle (Wettermann et al. 1978; Carter et al. 1980) suggesting that the long calving intervals normally reported in swamp buffaloes can be reduced through early weaning.

Similar effects of suckling on postpartum interval to first ovulation were also reported in dairy buffalo (El-Fouly et al. 1976; Unar et al. 1987). Suckling lengthened postpartum interval to first oestrus from 55 days in non-suckled dairy buffaloes to 73 days in suckled animals (Unar et al. 1987). A similar finding was reported for Nili-Ravi (riverine) buffaloes in which the postpartum interval to resumption of ovarian activity was lower in the non-suckled (weaning at birth) animals than those on limited suckling (twice daily for 2 min before milking) (Usmani et al. 1990). Similarly, hand-milking, a condition equivalent to calf removal or weaning, shortened the postpartum interval to first ovulation from 132 days in dairy buffaloes on twice suckling daily to 78 days (El-Fouly et al. 1976).

In Sri Lanka, buffaloes managed under a system of restricted suckling for the first few months of lactation had shorter postpartum interval to first service (57 days) when calved during the peak calving season as compared with 156 days in buffaloes calving outside the peak calving season (Perera et al. 1987), suggesting that season could exert its influence on postpartum ovarian activity independent of suckling. Prolonged postpartum anoestrus was the major reason for the long calving interval in
the animals that calved outside the peak calving season (Perera et al. 1987).

The reestablishment of normal LH pulse pattern is the key factor responsible for ovarian follicular development and the initiation of postpartum ovarian cyclicity in cattle and in other farm animals (Rahe et al. 1980; Rawlings et al. 1980; Lamming et al. 1982; Williams 1990). In beef cows, suckling reduces the frequency and amplitude of episodic LH peaks by 60% and 40% respectively, and delays the follicular maturation and first postpartum oestrus and ovulation in beef cows (Carruthers et al. 1980). The inhibitory effect of suckling was found to be mediated by a suppression of hypothalamic GnRH secretion which in turn suppressed the episodic release of LH (Carruthers and Hafs 1980; Peters et al. 1981). Weaning of calves removes the inhibitory effect of suckling on gonadotrophin release resulting in an increase of episodic LH release thereby promoting follicular development and ovulation (Walters et al. 1982; Edwards 1985; Whisnant et al. 1985). It has been suggested that suckling inhibits ovarian function in swamp buffalo not by an effect on the pituitary gland but rather on the GnRH release by the hypothalamus (Jainudeen et al. 1984).

The EW buffaloes regained body weight and restored good body condition earlier after calving than did the RS or S animals (Figure 2 and Figure 3). This improved body weight and body condition might have contributed to the early resumption of postpartum ovarian activity in the EW animals. The faster regain in body weight and body condition of the EW animals could be due to nutrients not being drained by milk removal through suckling. However, the absence of suckling stimulus in the EW group could be the most likely reason for earlier resumption of postpartum ovarian activity as calf removal or weaning eliminates the inhibitory effect of suckling on gonadotrophin release. As a result, the increased episodic LH release promotes follicular development and ovulation. In beef cattle, a shorter postpartum anoestrus period and higher LH pulse frequency were associated with cows of good body condition (Wright et al. 1992). In ewes, body condition had a direct influence on hypothalamic activity and GnRH secretion, rather than an effect on the pituitary sensitivity to GnRH signal (Rhind et al. 1989).

In contrast to early weaning, the S buffaloes lost body weight and body condition until 14 weeks postpartum. This prolonged loss of body weight might have further aggravated the suppressive effect of suckling on episodic LH release and could have a direct influence on hypothalamic activity and GnRH secretion of the buffaloes, as in ewes, resulting in delayed resumption of postpartum ovarian activity. However, loss in body condition could also be a reflection of the inability of the suckling buffaloes to consume enough food rather than due to nutrient drained by milk removal per se. Although in this study there is no significant effect of suckling frequency on postpartum body weight at various postpartum intervals (Table 2), except at 14 weeks postpartum, the trend in the change of body weight (Figure 3) shows that there was an influence of suckling frequency on body weight change. As for the RS group, the recovery in body condition which was similar to that of EW, was unexpected when the loss in body weight in the former group was similar to that of the S group. However, the shorter \( p < 0.05 \) postpartum interval to first ovulation in RS (67 days) than in S (91 days) is an indication that restricted suckling may exert a less suppressive effect on GnRH secretion and episodic LH release resulting in earlier onset of postpartum ovarian activity in the RS than S group. The earlier recovery in body condition in the RS group might have also contributed to the shorter postpartum interval similar to that in EW buffaloes. As neural stimuli are continuously present in suckling buffaloes, the delayed resumption of postpartum

Y. Nordin and M. R. Jainudeen
ovarian activity in the S group could be due
to the direct suppressive effect of suckling
on the GnRH release which in turn inhibited
the episodic release of LH required for
follicular development, maturation and
ovulation as observed in beef cattle.

The correlations shown in Table 5,
though in most cases were not significant,
suggest that length of postpartum interval to
first ovulation or oestrus to a certain extent
is influenced by body weight change and
body condition score irrespective of suckling
treatment. The positive correlation in the
relationship between body weight change
and postpartum intervals indicates that
increased body weight loss will prolong the
postpartum intervals while the negative
correlation between body condition score
and the postpartum intervals implies that
increased body condition score will reduce
the postpartum intervals.

From this study, it is concluded that
suckling delays while early weaning and
restricted suckling enhance early resumption
of postpartum ovarian activity in swamp
buffaloes. The delay in the resumption of
ovarian activity is not only due to the
suppressive effect of suckling but also can
be due to body weight and body condition
loss as a result of nutrient removal through
suckling. Therefore, this study supports the
hypothesis that if suckling is eliminated
there will be no nutrient drain and no loss in
body weight, hence, enhancing resumption
of postpartum ovarian activity of the animal.

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