SUCKLING BEHAVIOR OF CALVES WITH DAMS VARYING IN MILK PRODUCTION


University of Nebraska
Lincoln 68583

ABSTRACT

Two experiments were performed to test the hypothesis that suckling behavior of calves with similar growth potential varies depending on cows' level of estimated milk production and stage of lactation. Eleven mature cows, which varied in estimated 205-d milk production (996 to 2354 kg/205 d), nursing heifer calves of similar growth potential were used in Exp. 1. Suckling behavior of calves was observed for two 24-h periods at three stages of lactation (average of 52, 104 and 167 d postpartum). Suckling frequency (suckling bouts/24 h) declined as milk production increased at 52 d of lactation (−.00382 bouts/kg milk) but was unrelated to milk production at later stages. Duration of suckling (minutes/suckling bout) increased with estimated level of milk production at all stages of lactation (\(\sim .001556 \text{ min/kg milk}\)). Total time suckling tended to increase as estimated level of milk production decreased at 52 d of lactation, but this component of suckling behavior was unaffected by milk level at later stages. Suckling frequency declined from 8.6 bouts/24 h at 52 d of lactation to 4.5 bouts/24 h at 167 d of lactation when averaged across all cows. Total minutes nursed/24 h declined in a similar manner (64 min/24 h to 44 min/24 h) between 52 and 167 d of lactation. Duration of each suckling bout did not change with stage. In the second experiment the relationship of suckling behavior to estimated milk production was evaluated at four early stages (average of 17, 38, 59 and 80 d postpartum) of lactation using 20 mature cows. Variation in estimated 205-d milk production (1,034 to 2,237 kg/205 d) and growth potential of calves was similar to that of cows used in Exp. 1. Duration of postpartum anestrus as estimated by progesterone detected in weekly blood samples and the interval from calving to first behavioral estrus were also evaluated. Frequency of suckling declined (−.00185 bouts/kg milk) as milk production level increased. Total minutes nursed was related to estimated level of milk production only at 17 d of lactation (−.02649 min/kg milk). As in Exp. 1, frequency of suckling declined (11.3 bouts/24 h at 17 d of lactation to 3.8 bouts/24 h at 80 d of lactation) and total minutes nursed/24 h decreased (80 min/24 at 17 d to 42 min/24 h at 80 d) as lactation progressed. Again, duration was unaffected by stage of lactation. Length of postpartum anestrus at (days to first estrus) was unrelated to milk level and/or components of suckling behavior in this study. Data from these experiments confirm earlier reports that suckling behavior in calves varies with level of milk production of cows and indicate that the pattern of nursing changes as the lactation period progresses.

(Key Words: Behavior, Milk Production, Cows, Calves, Suckling.)

Introduction

Nursing and the degree of udder stimulation received via the calf's suckling are important regulators of postpartum reproductive function in beef cows. Nursing increases the length of postpartum anestrus (Casida et al., 1968), and as the degree of stimulus increases, the interval from calving to first estrus is extended (Wilbank and Cook, 1958; Wettemann et al., 1978; Randel et al., 1981; Reeves and Gaskins, 1981). An understanding of suckling behavior is important when conclusions regarding postpartum reproductive function are developed.
Certainly many environmental influences (nutrition, climate, geography, etc.) as well as genetic differences could influence this behavior and milk production. Nursing behavior would be expected to vary, depending upon the cows' ability to satisfy the nutritional needs of the calf. In previous investigations of suckling behavior of calves, three primary components of this behavior that were typically compared included frequency of sucking (suckling bouts/24 h), duration of suckling (average minutes nursing during each bout), and total minutes nursed (total minutes nursed/24 h). Several reports (Drewry et al., 1959; Hutchinson et al., 1962; Walker, 1962; Reinhardt and Reinhardt, 1981) indicated that suckling behavior varied with stage of lactation. In general, it was reported that duration of each nursing bout did not change, but that total minutes nursed and/or frequency of nursing declined as lactation progressed. Furthermore, Drewry et al. (1959) reported that the extent of this change was dependent on milk production of the dam. In contrast, Odde et al. (1985) reported that level of milk production by the dam, but not calf age, influenced suckling behavior in the calf. In the present study, two experiments were performed to compare suckling behavior in calves or dams that varied widely in milk production.

**Experimental Procedure**

Exp. 1. Six Hereford x Angus and five Milking Shorthorn x Angus cows and their natural calves were studied. These individuals were part of a herd of approximately 160 mature cows that had been developed to produce cows of similar mature body weight and size that varied in level of milk production (Clutter and Nielsen, 1984). Cows were selected from these crossbred groups to achieve animals with a wide range of estimated 205-d milk production. The 11 cows were also selected with consideration for cow age, sex of calf and date of calving. Nine cows were 4 yr of age and two were 5 yr of age. Cows were chosen from these age groups since they were approaching mature size and peak level of milk production (Clutter and Nielsen, 1984). Cows were selected from these crossbred groups to achieve animals with a wide range of estimated 205-d milk production. The 11 cows were also selected with consideration for cow age, sex of calf and date of calving. Nine cows were 4 yr of age and two were 5 yr of age. Cows were chosen from these age groups since they were approaching mature size and peak level of milk production.

All calves were Charolais-sired heifer calves, born between March 10 and March 24, 1983. Thus, all calves were 1/2 Charolais and 1/4 Angus, with the remaining 25% being either Hereford or Milking Shorthorn.

Estimated 205-d milk production ranged from 996 to 2,354 kg/205 d based upon estimates from the 1981 and 1982 lactations in the cows used. Milk production was estimated again in 1983 and all 3 yr of data were used for statistical analyses. Milk production (kg/205 d) was estimated using the calf suckling technique at approximately 50, 100 and 150 d of lactation as described by Clutter and Nielsen (1987). The Hereford x Angus cows studied represented the cows with lower milk production (1,138+ 47 kg/205 d; \( \bar{X} \pm SE \)); the Milking Shorthorn x Angus cows were the cows with higher milk production (1,951 \( \pm 115 \) kg/205 d). All cow-calf pairs were maintained together on high-quality bromegrass pasture during the experiment at a research unit in Southeast Nebraska. Supplemental alfalfa hay was provided until May 1.

Suckling behavior was observed at three stages of lactation (averaging 52, 104 and 167 d postpartum). At each stage, cow-calf pairs were observed for two 24-h periods, which were separated by 24 h of no observation. Cow-calf pairs were moved to a small pasture 2 to 3 d before the first 24-h observation period at each stage of lactation. Identification numbers were painted on both sides of the cows and calves 1 to 2 d before the first observation. Observation started at 0800 and continued until 0800 the following day. The second observation period was initiated 24 h after termination of the first period. Suckling behavior was observed from a motorized vehicle by two technicians throughout the experiment. Technicians worked on three 8-h shifts during each 24-h period. Observations in darkness were aided by use of a night vision scope ("starlight scope") and an infrared spotlight. Cow and calf numbers and the starting and ending times of each nursing event were recorded during observation. A nursing bout was defined as any detectable period of calf-teat contact that was subjectively determined to represent suckling. This period was not restricted to a minimal duration.

Exp. 2. Ten Hereford x Angus and ten Milking Shorthorn x Angus cows from the herd described in Exp. 1 were studied in Exp. 2. The 1981, 1982 and 1983 milk production records were used to choose cows for this experiment. All cows were 5 to 6 yr of age and were nursing their natural Charolais-sired calves (five heifer and five bull calves per breed-class). All calves were born between March 12 and March 24, 1984. Average 205-d milk yield for the 1981, 1982 and 1983 lactations for these cows ranged from 1,034 to 2,237 kg. The selected Hereford
Angus cows averaged 1,206 ± 40 kg/205 d; the selected Milking Shorthorn × Angus cows averaged 1,911 ± 56 kg/205 d over the three lactations. Cow-calf pairs were managed as described for Exp. 1.

Suckling behavior data were collected for 24 h at an average of 17, 38, 59 and 80 d post-partum. Observations were performed and data were collected as described for Exp. 1, except only single-day collections occurred at each stage of lactation. Based on results from Exp. 1, it was apparent that single observations rather than two 24-h periods were adequate to evaluate behavior. Also, the calves and cows were observed in the pasture where they were collectively maintained rather than moving them to another location from the collection of data. Blood samples were collected weekly from all cows starting the week following calving and extending through the 13th week postpartum. Progesterone concentration was determined in plasma by radioimmunoassay as described by Anthony et al. (1981). Intra- and inter-assay coefficients of variation were 3.6 and 13.8%, respectively. Re-initiation of estrous cycles was determined as described previously (Zalesky et al., 1984). Behavioral estrus was observed through the 13th week with the aid of androgenized cows.

**Data Reduction.** Data regarding three characteristics of suckling behavior were derived from information recorded during observation periods. Frequency of nursing, duration of each nursing bout and total minutes nursed were calculated in both experiments for each stage of lactation. Frequency of nursing was calculated as the total number of times that the calf suckled the cow during a 24-h period. Duration of nursing was calculated as the average length of time that the calf suckled the cow at each nursing bout during a 24-h period, and total minutes nursed was the sum of the durations of all nursing bouts/calf in 24 h. In Exp. 1, these values represented the average of the two 24-h periods of observation that were performed at each stage. In Exp. 2, cow-calf pairs were observed for only one 24-h period at each stage of lactation. Also, in Exp. 2, days to first behavioral estrus and days to the first estrous cycle of normal duration following calving were calculated.

**Statistical Analyses.** The characteristics of suckling behavior were analyzed with a model that included stage of lactation, the linear regression of suckling behavior characteristics on estimated 205-d milk production and the interaction of stage of lactation and milk production level. In both experiments, the value used for estimated 205-d milk production for a cow was the average for three lactations, from 1981, 1982 and 1983. Correlations of reproductive measurements with estimated 205-d milk production and with suckling characteristics were calculated. The average of three lactations was used in all statistical analyses because it should have less error than a single year’s data on milk production. In Exp. 2, sex of calf was initially included in the model but was later omitted due to the lack of significance.

**Results**

**Exp. 1.** The mean values for the characteristics of nursing during the various stages of lactation in Exp. 1 are presented in table 1. Averaged over all cows, frequency of nursing and total minutes nursed declined as lactation progressed (P<.05), but duration of each nursing bout did not change. However, an interaction (P<.05) of stage of lactation with the regression of frequency of nursing on milk production level was detected (figure 1). Frequency of nursing declined (−.00382 nursing bouts/kg milk; P<.05) as estimated milk production increased at 52 d of lactation but not at 104 or 167 d of lactation. This interaction was primarily the result of a decline in the nursing frequency at 104 and 167 d of lactation of lower milking dams.

<table>
<thead>
<tr>
<th>Stage of lactation</th>
<th>Frequency of nursing</th>
<th>Duration of each nursing</th>
<th>Total min nursed</th>
</tr>
</thead>
<tbody>
<tr>
<td>52</td>
<td>8.6</td>
<td>7.8</td>
<td>64</td>
</tr>
<tr>
<td>104</td>
<td>5.9</td>
<td>8.6</td>
<td>49</td>
</tr>
<tr>
<td>167</td>
<td>4.5</td>
<td>9.8</td>
<td>44</td>
</tr>
<tr>
<td>Avg</td>
<td>6.3</td>
<td>8.7</td>
<td>52</td>
</tr>
</tbody>
</table>

*a* In relation to parturition.

*b* Number of nursing events recorded in a 24-h period.

*c* Stage effect (P<.05).

*d* Average duration of each nursing event (min) during a 24-h period.

*e* Total minutes spent nursing during a 24-h period.
Milk Production Level (kg/205d)

Figure 1. The partial regression of number of nursing bouts/24 h on milk production level for Exp. 1 at 52, 104 and 167 d of lactation. Interaction of regression at different stages of lactation was significant (P<.03). Partial regression was significant (P<.05) at 52 d of lactation.

A similar relationship was observed for total minutes nursed/24 h (figure 2), although the interaction only approached significance (P<.09). Total minutes nursed was negatively related to milk production level (−.01369 min/kg milk during the 205 d of lactation; P<.05) at 52 d of lactation but was unrelated to milk production level at later stages. As was the case for frequency of nursing, calves with lower milking dams suckled for fewer total minutes daily as stage of lactation progressed whereas calves with higher milking dams did not.

Duration of each nursing bout increased with estimated milk production (P<.05) at all stages of lactation (−.001556 min/kg milk) and was similar across stages. The pattern of nursing bouts throughout the 24-h observation periods is presented in table 2.

Exp. 2. The mean values across all cows for each characteristic of nursing at the various stages of lactation in Exp. 2 are presented in table 3. As in Exp. 1, frequency of nursing and total minutes nursed/24 h declined as lactation progressed and duration did not change. Frequency of nursing declined (P<.01) as milk production level increased (−.00185 nursing bouts/kg of milk). The interaction with stage was nonsignificant.

The regression of total minutes nursed on milk level tended to change as stage of lactation progressed (P=.08; figure 3). At 17 d of lactation, calves with dams of lower milk production suckled for more total minutes each day than calves with higher milking dams (−.02649 min/kg milk; P<.05) but a similar relationship did not exist at later stages of lactation. The duration of each nursing bout increased as estimated milk production increased (P<.01; x̄=.001835 min/kg milk). This relationship did not change significantly as lactation progressed.

Length of postpartum anestrus or days to first behavioral estrus were not related to any characteristics of nursing behavior nor to milk level. Days to first behavioral estrus and the first estrous cycle of normal duration from parturition were 62.7 ± 6.1 and 68.4 ± 6.5, respectively.

Discussion

Level of estimated milk production by the dam and stage of lactation both significantly affected suckling behavior of calves. To summarize, calves nursing dams with lower levels of milk production suckled more frequently but for a shorter length of time at each nursing bout in early stages of lactation. Although duration of each bout was shorter for calves suckling lower-producing cows, they suckled for more total minutes each day. Later in lactation, calves suckling lower-milking cows continued to suckle for a shorter period of time each bout; however, frequency of nursing and total minutes nursed/24 h was not related to milk level. Across all cows, the number of times calves suckled in a day and the total minutes suckled/24 h declined as lactation progressed within both experiments. The duration of each bout did not vary with stage of lactation.

Odde et al. (1985) reported that age of calf (i.e., stage of lactation) was unrelated to

Figure 2. The partial regression of total minutes nursed/24 h on milk production level for Exp. 1 at 52, 104 and 167 d of lactation. Interaction of regression at different stages of lactation (P<.10). Partial regression was significant (P<.05) at 52 d of lactation.
suckling behavior. This report is inconsistent with results from the present study and earlier reports (Drewry et al., 1959; Hutchison et al., 1962; Walker, 1962; Reinhardt and Reinhardt, 1981). The relationship of milk production to suckling behavior reported by Odde et al. (1985) was consistent with observations during early stages of lactation in the present study and with observations made in earlier investigations (Drewry et al., 1959). A possible explanation for inconsistencies between investigations may be derived from evaluation of figures 1, 2 and 3. It is evident that the decline in frequency of nursing and total minutes nursed primarily resulted from a decrease in these characteristics by calves suckling lower milking cows. For example, the estimate from figure 1 that suckling frequency of a calf with a dam that produces 900 kg milk/205 d would decline from 11 bouts/d to 5 bouts/d between 52 and 167 d postpartum, respectively. In contrast, a calf suckling a cow producing 2,400 kg/205 d would be expected to suckle 6 times/d at 52 d of lactation and 5 times/d at 167 d of lactation. Total minutes nursed/24 h followed a similar trend in both experiments. Thus, results obtained for suckling behavior in relation to stage of lactation would be expected to vary depending upon milk production level of cows observed. A physiological explanation for the deviation in behavior during lactation dependent upon milk production level is speculative at present. Perhaps, as lactation progresses, dams with lower levels of milk production may be less capable of satisfying the appetite of their calves as compared with dams with higher milk production. Thus calves from dams that produce less milk might turn to alternative feedstuffs because of decreased milk production. The difference in the time course of these adjustments in sucking behavior between the two experiments might be explained by the subjective observation that nutritional plane was higher for dams in the second as compared with dams in the first experiment at the stages when behavioral data were collected.

Days to first estrus were unrelated to suckling behavior in Exp. 2. As milk production increased, the degree of sucking stimulus declined. In higher-producing cows, the increased nutritional requirement to produce milk may be balanced out somewhat by a reduction in sucking stimulus.

TABLE 2. TOTAL SUCKLING BOUTS FOR EXPERIMENT 1 BY HOUR OF DAY

<table>
<thead>
<tr>
<th>Time</th>
<th>Suckling frequency&lt;sup&gt;a&lt;/sup&gt;</th>
<th>Time</th>
<th>Suckling frequency&lt;sup&gt;a&lt;/sup&gt;</th>
</tr>
</thead>
<tbody>
<tr>
<td>0000</td>
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<td>1200</td>
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<tr>
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<td>1300</td>
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<td>1400</td>
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<td>0300</td>
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<tr>
<td>0600</td>
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<td>1800</td>
<td>22</td>
</tr>
<tr>
<td>0700</td>
<td>12</td>
<td>1900</td>
<td>33</td>
</tr>
<tr>
<td>0800</td>
<td>33</td>
<td>2000</td>
<td>23</td>
</tr>
<tr>
<td>0900</td>
<td>15</td>
<td>2100</td>
<td>7</td>
</tr>
<tr>
<td>1000</td>
<td>23</td>
<td>2200</td>
<td>1</td>
</tr>
<tr>
<td>1100</td>
<td>17</td>
<td>2300</td>
<td>16</td>
</tr>
</tbody>
</table>

<sup>a</sup>Total number of suckling bouts during the six observation periods. Data were recorded during two 24-h observation periods when calves were approximately 52, 104 and 167 d of age.
TABLE 3. SUCKLING BEHAVIOR AT FOUR STAGES OF LACTATION (EXPERIMENT 2)

<table>
<thead>
<tr>
<th>Stage of lactation</th>
<th>Frequency of nursing</th>
<th>Duration of nursing</th>
<th>Total minutes nursed</th>
</tr>
</thead>
<tbody>
<tr>
<td>17</td>
<td>11.3</td>
<td>7.6</td>
<td>80</td>
</tr>
<tr>
<td>38</td>
<td>7.3</td>
<td>8.2</td>
<td>57</td>
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<tr>
<td>59</td>
<td>5.6</td>
<td>8.7</td>
<td>47</td>
</tr>
<tr>
<td>80</td>
<td>7.0</td>
<td>8.9</td>
<td>57</td>
</tr>
</tbody>
</table>

\(a\) In relation to parturition.

\(b\) Number of nursing events recorded in a 24-h period.

\(c\) Average duration of each nursing event (min) during a 24-h period.

\(d\) Total minutes spent nursing during a 24-h period.

\(e\) Stage effect (P<.05).

The possibility of genotypic differences in suckling behavior of calves or of differences in maternal effects on behavior of calves suckling cows of different breed types cannot be evaluated from these data. Cows were chosen for this study from two breed-cross groups that differed in milk production in order to evaluate a wide range of milk levels, thus, milk production level and breed-cross of the cow were confounded in both experiments. The possibility exists that the relationship of suckling behavior to milk production level was partially a result of a difference in maternal effects on nursing characteristics between the Hereford-cross and Milking Shorthorn-cross cows. The calves used in both experiments were similar in breeding, except that calves with dams that had higher levels of milk production were 25% Milking Shorthorn and calves with dams that produced less milk were 25% Hereford. It is possible that this difference had an effect on the results that were obtained.

In conclusion, it is clear from these data and previous reports that level of milk production affects suckling behavior of calves. The degree of variation in behavior as lactation progresses is dependent upon milk level of cows. Finally, in this study, the interval from parturition to estrus was not related to degree of suckling stimulus received by cows that varied in milk production and were nursing calves ad libitum.

**Literature Cited**


