Effects of Suckling on Postpartum Reproductive Performance of Beef Cows and Growth of Their Calves

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Introduction

Maintenance of a 12-month calving is important for optimum production of a cow herd. According to several recent reports^{5,10}, it has been estimated that the calving interval of Japanese Black cows is 13 to 15 months. Many management methods for reducing the calving interval have been studied. Factors affecting this interval are age of cow⁶, level of nutrition^{3,27}, calving season⁷ and suckling intensity^{2,15,16}.

The interval from calving to postpartum estrus has been shown to be longer in suckled beef cows than in nonsuckled and milked cows^{11,17}). Other reports^{1,8}) indicate that suckling stimulus is a major cause of the delayed return to estrus and, subsequently, delayed conception in postpartum beef cows. In Japanese Black cows, however, little investigation of the relationship between suckling regimes and postpartum reproductive performance has been conducted. The author^{18,20-24}) has made the relationship clear and tried to find out an efficient suckling regime which would make possible the reduced calving interval. In this article the effects of various suckling regimes on postpartum reproductive performance of Japanese Black cows and growth of their calves will be briefly presented, and improvement of beef cow-calf performance will be discussed.

Effect of early weaning on postpartum ovarian activity

Postpartum ovarian activity was investigated in 140 Japanese Black cows that weaned calves at various days postpartum.

1) Postpartum first ovulation and first estrus

Postpartum intervals to the first ovulation and the first estrus in early-weaned beef cows are shown in Table 1. The longer the postpartum days of weaning (X), the longer the postpartum days (Y) to the first ovulation and to the first estrus, and regressions Y=15.70 + 0.176X for the first ovulation and $Y=27.23 + 0.356X-0.00193X^2$ for the first estrus were obtained by Gram-Shmidt's orthonormalization.

As shown in Fig. 1(a), both the first ovulation and the first estrus occurred early in the postpartum period in most cows that weaned calves immediately after calving or at 3 days postpartum. Particularly, the first ovulations occurred simultaneously between 9 and 15 days postpartum and about half of them were accompanied by estrous behavior in these cows. Therefore, more than 90% of these cows returned to the first estrus until 39 days postpartum. In contrast, both the occurrence of the first ovulation and that of the first estrus varied during the long

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Postpartum days of weaning	No of	First ovulation	(postpartum days)	First estrus (postpartum days)		
	cows	Observed	Estimateday	Observed	Estimated ^{b)}	
0	12	12.6	15.7±3.59*	17.4	27±4.4	
3	32	16.0	16.2 ± 2.45	24.5	28 ± 5.5	
30	9	24.2	21.0 ± 3.78	39.4	36 ± 5.4	
60	22	28.4	26.3 ± 2.50	49.5	41 ± 4.0	
90	65	30.9	31.5 ± 1.85	44.1	44±2.2	

Table 1. Postpartum first ovulation and first estrus in early-weaned beef cows

* Mean±SE

a): Y=15.7+0.176X (X: postpartum days of weaning)

b) : $Y = 27.23 \pm 0.356X \pm 0.00193X^2$



Fig. 1. Occurrences of postpartum first ovulation and first estrus in 44 beef cows that weaned calves immediately after calving or at 3 days postpartum (a) and in 65 beef cows that weaned calves at 90 days postpartum (b)

: Percentage of cows exhibiting estrous behavior at the first ovulation.

Itom	Postpartum days of weaning					
item	0	3	30	60	90	SE
No. of cows	12	32	9	22	65	140
No. of cows exhibiting estrus at 1st ovulation	8	16	1	1	12	38
Intervals from (days):	(a)			15		NO.
1st to 2nd ovulation*	15.2	17.4	15.2	12.4	14.1	0.46
2nd to 3rd ovulation	21.5	21.0	21.8	20.2	21.1	0.25
Peak serum progesterone levels (ng/ml) ^{a)} after:						0.00
1st ovulation**	2.85	2.56	2.17	1.31	1.67	0.213
2nd ovulation	4.51	5.04	4.31	5.30	5.45	0.239
Postpartum days to conception	60.3	61.8	56.6	66.7	66.6	2.20
No. of inseminations per conception	1.70	1.63	1.33	1.27	1.48	0.07

Table 2. Postpartum ovarian function and conception in early-weaned beef cows

a): Progesterone concentrations were determined by radioimmunoassay in blood collected from 10, 14,

7, 10 and 25 cows that weaned calves at 0, 3, 30, 60 and 90 days postpartum, respectively.

* Significantly shorter than the interval from 2nd to 3rd ovulation in all groups (P<0.05).

** Significantly lower than that after 2nd ovulation in all groups (P<0.05).

period postpartum in the cows that weaned calves at 90 days postpartum (Fig. 1(b)). In addition, almost all the first ovulations were not accompanied by estrous behavior in the cows that weaned calves at more than 30 days postpartum (Table 2). Furthermore, suckling of calves increased the proportion of cows not exhibiting estrus at the second ovulation.

These results reveal that the suckling not only delays the resumption of ovarian activity but also inhibits the estrus occurrence early in the postpartum period. It has been suggested that the pulsatile LH pattern is a prerequisite for the onset of ovarian cycles early in the postpartum period, and that suckling might inhibit ovarian activity via an effect on gonadotrophin release^{4,12,13}.

2) Function of corpus luteum after the first ovulation

No differences were found in the interval from the first to the second ovulation and serum progesterone levels at the peak during the estrous cycles among the cows that weaned calves at various days postpartum (Table 2). The interval from the first to the second ovulation was shorter than the next interval from the second to the third ovulation, and serum progesterone levels at the peak after the first ovulation were lower than those after



Fig. 2. Postpartum changes in serum progesterone concentrations of beef cows that weaned calves at 60 days postpartum Day 0=day of calving o: quiet ovulation, E: estrus.

the second ovulation in all groups. It was also confirmed by rectal examination that corpora lutea formed after the first ovulation were small in size and tended to regress

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earlier. These results indicate that most of corpora lutea formed after the first ovulation are not fully functional. Such an ovarian activity in postpartum cows was very similar to that in heiters during pre- and post-puberal periods¹⁹⁾. With regard to this point, it is suggested that the lower levels of FSH observed before the first ovulation may be an important factor contributing to the reduced life span of subsequent corpus luteum¹⁴⁾.

Postpartum changes in serum progesterone concentrations were shown in Fig. 2 for the cows that weaned calves at 60 days postpartum.

Starting breeding at about 40 days postpartum resulted in an equal interval from calving to conception among all groups. They all conceived by 70 days postpartum, indicating that it is possible to maintain 12-month calving. But an average number of insemination required for conception tended to be more in the cows that weaned calves early in the postpartum period (Table 2). This result might be associated with the finding that early weaning tended to delay the postpartal uterine involution in beef cows⁹.

Effect of restricted suckling

Early weaning had a marked effect on the

resumption of ovarian activity in the postpartum beef cows. However, suckling or milk production is of importance as mothering ability of a beef cow.

In a search for an efficient calf production system, the experiments were conducted (i) to determine the effects of limiting suckling to once or twice a day on postpartum reproductive performance of dams and growth of their calves, and (ii) to evaluate the effect of concentrate supplements on the growth and ingestive behavior of calves on restricted suckling regimes. Thirty cow-calf pairs were divided into three groups of once-daily, twicedaily and normal suckling after calving. Restricted suckling was initiated at 4 days and continued until 90 days postpartum.

 Reproductive performance of cows Restrictively suckled cows gained slightly or were unchanged in body weight during the 3 postpartum months, while normally suckled cows lost 17 kg. This was probably due to suppression of grazing activity in the cows with suckled calves²¹.

As shown in Table 3, reduced suckling frequency resulted in shorter postpartum intervals to the first ovulation, first estrus and conception. But no significant differences were found in these intervals among the three

	Suckling regime*				
Item	Once-daily suckling	Twice-daily suckling	Normal suckling		
No. of cows	10	12	8		
Postpartum days to 1st ovulation	21.9 ± 5.8^{a}	24.6 \pm 7.3 ^a	28.6 ± 8.1 ^a		
lst estrus	27.9 ± 11.3^{a}	36.5 ±13.5 ^{ab}	44.4 ±18.6 ^b		
conception	46.0 ±10.1 ^a	50.1 ±13.9ª	61.9 ± 29.6^{a}		
No. of cows exhibiting estrus at 1st ovulation $(\%)$	5 (50.0%)	3 (25.0%)	1 (12.5%)		
No. of inseminations per conception	1.4 ± 0.5^{a}	1.3 ± 0.7^{a}	1.4 ± 0.8^{a}		
Average daily gain of calves (kg)**:					
no creep feed	0.53 ± 0.13^{a}	0.81 ± 0.16^{b}	0.87± 0.17 ^b		
with creep feed	$0.82\pm~0.10^a$	0.88 ± 0.08^{a}			

Table 3. Effects of restricted suckling on postpartum reproductive performance of beef cows and growth of their calves

* Restricted suckilng was initiated at 4 days and continued until 90 days postpartum.

** From birth to 90 days of age.

a, b: Significant (P<0.05) differences on the same line are indicated by different superscripts. Each value is expressed as mean \pm SD.

groups, except for the interval to the first estrus between once-daily and normal suckling groups. The 21.9-day and 24.6-day intervals to the first ovulation for once-daily and twice-daily suckled cows closely approximate those reported for two- and four-times milking dairy cows2). Then, the 27.9-day interval to the first estrus for once-daily suckled cows is more than those for nonsuckled cows and is less than those for beef cows that weaned calves at 30 or 60 days postpartum. In general, postpartum interval to the first estrus is longer and variable among the suckled beef cows under grazing condition¹⁵⁾. In this study reduced suckling frequency did not markedly shorten the postpartum intervals. These intervals, however, tended to be shorter and variability appeared to be less in the restrictively suckled cows.

Restricted suckling also increased the number of cows exhibiting estrous behavior at the first ovulation (Table 3). There were no differences in other ovarian characteristics, such as progesterone concentrations and interval from the first to the second ovulation among the three groups.

2) Growth and ingestive behavior of calves

Without concentrate supplements, average daily gain from birth to weaning was significantly lower for once-daily suckled calves than for twice-daily and normally suckled calves. Growth of once-daily suckled calves, however, was markedly improved by concentrate supplements, and was similar to twice-daily suckled calves (Table 3).

Fig. 3 shows the changes with age in daily intakes of concentrate, hay, and milk by restrictively suckled calves. Although daily hay intake was almost the same in both the oncedaily and twice-daily suckled calves throughout the period of 3 months, once-daily suckled calves ingested about twice the concentrate twice-daily suckled calves did. Ingestive behavior was similar for all calves at 10 and 25 days of age. As the calves grew older, once-daily suckled calves tended to spend more time in ingesting concentrates, whereas twice-



Fig. 3. Changes with age in daily intakes of concentrate(—), hay (----), and milk (---) by once-daily suckled (°) and twice-daily suckled (•) calves

daily suckled calves spent more time in ingesting hay. This observation appears to agree with the report²⁵⁾ that time-controlled nursing seems to increase eating time and amounts of creep feed by the calves on pasture or range.

It is concluded from the data on cows and calves that restricted suckling would have a desirable effect on cow performance, and that even once-daily suckling would not reduce the growth rate of calves if the concentrate supplements were available.

Effect of short-term restricted suckling

The experiment was conducted to clarify the effects of short-term restricted suckling in early postpartum on the reproductive performance and milk production of beef cows and growth of their calves. Thirty-one Japanese Black cows were assigned to three groups: once-daily suckling from 4 to 14 days postpartum (gorup I), once-daily suckling from 15 to 28 days postpartum (group II) and normal suckling throughout the period of 90 days postpartum (group III). During the restricted suckling period, the calves in groups

Table 4. Number of cows showing a follicle with a diameter>10 mm and that showing postpartum first ovulation at various postpartum periods in the cows treated with short-term restricted suckling

Group	Period of restricted suckling*	No. of cows	Follicle>1	0 mm dia.		Postpart	um first o	ovulation	
			Days postpartum		Days postpartum				
	(days postpartum)		10	20	0-14	15-28	29-42	43-56	57—70
I	4-14	11	7**	7	0**	6	2	2	1
п	15-28	10	2	8**	0	7**	3	0	0
ш	3 -3	10	2	4	0	2	3	2	3

* Suckling was allowed for 30 min once daily.

** During once-daily suckling period.

Table 5.	Effects of short-term	restricted suckling	on postpartum	reproductive	perfor-
	mance of beef cows a	nd growth and mill	a intake of their	r calves	

	Group I	п	ш			
Item	Period of restricted suckling (days postpartum)*					
	414	15—28				
No. of cows	11	10	10			
Postpartum days to 1st ovulation	33.8 ±13.1 ^{ab}	26.5 \pm 5.7 ^a	43.9 ±15.4 ^b			
1st estrus	46.6 ±13.5 ^b	35.7 \pm 6.7 ^a	58.2 ±18.5 ^b			
conception	51.5 ±13.1ª	57.4 $\pm 27.6^{a}$	85.1 ±24.2 ^b			
No. inseminations per conception	1.1 ± 0.3^{a}	1.5 ± 0.9^{ab}	1.9 ± 0.9^{b}			
Average daily gain (kg)**	0.66 ± 0.15^{a}	0.68 ± 0.09^{a}	0.75± 0.17ª			
Average daily milk intake (kg)**	5.30 ± 1.70^{a}	5.16 ± 0.92^{a}	$5.95 \pm 2.06^{\circ}$			

* Suckling was allowed for 30 min once daily.

** From birth to 90 days of age.

a, b: Significant (P<0.05) differences on the same line are indicated by different superscripts. Each value is expressed as mean \pm SD.

Each value is expressed as mean ±00.

I and II were separated from their dams and kept in a calf pen except for their suckling time of 30 min once a day. After that, the calves were allowed to suckle ad libitum until weaning at 90 days of age.

Growth of follicle and occurrence of the first ovulation are shown in Table 4. Oncedaily suckling hastened follicular growth early in the postpartum period, but no ovulations occurred in group I during its restricted suckling period. In contrast, 70% of the first ovulations occurred in group II during its restricted suckling period, as compared with 55% in group I and 20% in group III during the same period. This result reveals that short-term restricted suckling hastens follicular growth, but that effect on ovulation becomes greater during the period after about 20 days postpartum. Peters et al.¹²) reported that a distinct pulsatile pattern was seen between 13 and 20 days postpartum in the profiles of milked but not of suckling cows. Furthermore, Walters et al.²⁶) reported that cows weaned at 21 days postpartum had more pulses of LH during the 96-hr period from weaning and had greater number in follicular LH receptors than suckled cows.

As shown in Table 5, group II had a significantly shorter postpartum interval to the first ovulation than group III, and also had a significantly shorter interval to the first estrus than groups I and III. The postpartum interval to conception was shorter for groups I and II than group III.



Fig. 4. Changes with age in daily milk intake of calves exposed to short-term restricted suckling

* During the period of once-daily suckling.

** See Table 4.

Calf gain and milk intake (Fig. 4) were lower during the once-daily suckling period. But there were no significant differences in the average daily gain and the amount of average daily milk intake of calves from birth to 90 days of age among the three groups. These results indicate that once-daily suckling for a period of about 2 weeks beginning 15 days postpartum hastens the resumption of cyclic ovarian activity without affecting the milk production of cows and the growth of their calves.

Conclusion

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Early weaning markedly shortened the postpartum intervals to the first ovulation and first estrus, yet it produces the management of rearing early-weaned calves. The results obtained in our experiments indicate that restricted suckling is the more efficient method to improve the beef cow-calf performance. The procedure, however, is laborious in separating calves from their dams after every suckling when a cow herd is large. In the practical use of the restricted suckling regimes, a system of separating calves on a large scale must be established and producers should choose the most effective one among the various restricted suckling regimes, considering their own management system.

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(Received for publication, October 8, 1986)