The effects of restricted suckling and prepartum nutritional level on reproductive performance of primiparous crossbred beef cows

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ABSTRACT

Reproductive performance was recorded in a total of 21 two-year-old Hereford x Friesian and Simmental x Friesian primiparous cows before and after restriction of calf suckling. Cows were allocated one of two pastures allowances from day 112 to 212 of gestation so that the high nutrition (HN) group gained 0.75 kg/d, and the low nutrition (LN) group gained 0.17 kg/d during mid-gestation. Suckling was suppressed for 7 days by fitting nose plates to 46-day-old calves in the restricted suckling (RS) group, whereas the normal suckling (NS) group remained as a control. Dominant follicles in the ovaries occurred in all cows by day 32 *post partum* and underwent a pattern of growth and atresia before first ovulation. Restricted suckling cows had a shorter interval from calving to conception than NS cows (76.0 ± 5 vs 94.1 ± 6 days, $P<0.05$), whereas genotype and nutritional treatment had no effect on interval to conception. However, the beneficial effect of suckling restriction on days from calving to conception only occurred in cows fed the high herbage allowance in mid-gestation. RS calves spent more time grazing during the period of attachment of nose plates and differences in behaviour remained over a further 5 days after nose plates were removed (62.4 ± 7 vs 38.6 ± 7 minutes spent grazing; $P<0.001$), but were lighter at weaning (146.7 ± 3 vs 162.4 ± 3 kg; $P<0.01$). Despite the lower calf liveweight at weaning it is concluded that manipulation of suckling through fitting nose plates to calves can be used to initiate earlier re-breeding in primiparous cows.

Keywords: Beef heifers; post-partum reproduction; suckling behaviour; nose plates.

INTRODUCTION

The importance of the post-partum anoestrous interval (PPAI) in influencing the pregnancy rate of beef cows from a restricted breeding season has been highlighted by many New Zealand authors (Tervit *et al.*, 1977; Knight and Nicoll, 1978; Montgomery, 1984). A long PPAI is often reported for first calving suckled cows (Knight and Nicoll, 1978; Pleasants and Barton, 1992; Pleasants and McCall, 1993) and the effect is that the interval to the next calving is often longer than 365 days, and with an extended spread of calving dates within the herd. Management practices such as temporary weaning (Tervit *et al.*, 1982), and once or twice daily suckling in contrast to more frequent nursing (Montgomery, 1982) have been used in New Zealand to reduce PPAI and increase conception rate. The objective of this experiment was to study the effect of suckling restriction by fitting nose plates to calves on the interval to mating and conception in first calving crossbred beef cows that had been managed at two nutritional levels in mid-gestation.

MATERIALS AND METHODS

A total of twenty-one 2-year old Hereford x Friesian (HxF) and Simmental x Friesian (SxF) in-calf heifers were selected from a larger herd and randomly allocated to one of two pasture allowances, from March to June (mean days 112-212 of gestation). The high nutrition (HN) group grazed a pre-grazing herbage mass of 2000 kg DM/ha to a post-grazing mass of 1000 kg DM/ha. The low nutrition (LN) group grazed on the paddock previously available to the HN animals and fed to a post-grazing mass of 700 kg DM/ha. For the last 70 days of gestation, heifers were grazed at maintenance levels, approximately 5 to 6 kg DM/d.

Heifers commenced calving on 18 August with mean calving date of 28 August. Cows and calves were weighed at regular intervals from birth to weaning (December 14). Cow body condition score (1 = very thin, 5 = very fat, Lowman et al., 1976) was recorded at the end of the nutritional treatment, at calving and fortnightly from calving to weaning. Two entire Friesian bulls were run with the cows from day 20 *post partum* and remained with the herd until 5 January 1993.

At 46 days *post partum*, heifers were randomly assigned within breed and nutritional treatment to either a restricted suckling (RS) or normal suckling (NS) group. Suckling was suppressed for 7 days by fitting nose plates (Walmur, Uruguay) to calves in the RS group, whereas NS calves could suckle their mothers normally. During the period of differential suckling, RS and NS groups grazed in adjacent paddocks of similar botanical composition and herbage allowance. At the end of that period, RS and NS groups were managed together again.

Three-hour observations of calf suckling behaviour were carried out before, during and after fitting nose plates in the older calves of both RS and NS groups (19 animals). Suckling or attempting to suckle (if calves had nose plates), idling and grazing activity were recorded at 10 minute intervals, from 0600 - 0900 h on a total of 10 days.

Observations on the ovaries to record follicles and corpora lutea were made using ultrasonography (Aloka, Echo Camera, Japan, with a 5 megahertz probe) at weekly intervals from day 25 to approximately day 115 *post partum*.

Blood samples were collected by tail venipuncture at weekly intervals from approximately day 18 until day 115 *post partum* and a further three samplings were taken at 10 day intervals. Plasma progesterone concentrations were determined using the radioimmunoassay validated by Kirkwood *et al.* (1984). Assay sensitivity was 0.05 ng ml^{-1} and intra- and inter-assay coefficients of variation were 11.98% and 13.45%, respectively. Resumption of oestrous cycles was determined based on either of the two criteria: serum progesterone concentration of above 1 ng ml^{-1} for two consecutive weeks or serum progesterone concentrations ≥ 2 ng ml^{-1} in a single sample, as used by Zalesky *et al.* (1984). The progesterone assays continued on each heifer until at least four consecutive samples with values > 1 ng/ml were recorded to confirm pregnancy.

Heifers were slaughtered on 8 March and from the gravid uterine horn, the foetus was removed and its fetal age determined by crown-rump measurements (Harris *et al.*, 1983). The interval from calving to conception was calculated as the difference between calving date and conception date.

STATISTICAL ANALYSIS

Main effects in the model were suckling (restricted and normal), pre-partum nutrition (high and low), and dam genotype (HxF and SxF). Data were analyzed by least-squares analysis of variance using the general lineal model procedure of Statistical Analysis System (SAS, 1985). Two- and three-way interactions were calculated and tested for significance. If they were not significant, the interactions were deleted and the model refitted. Effects on post-partum interval to conception were analysed after adjustment for calving date.

RESULTS

The mean liveweight of cows on the nutritional treatments is presented in Table 1. Daily liveweight gain of cows from calving to weaning was not influenced by level of pregnancy nutrition, genotype nor suckling treatment. Calf birth weight was not affected by nutritional treatment of their dams (34.3 ± 0.9 vs 33.7 ± 0.8 kg, HN and NS respectively). Calf liveweight gain from birth to weaning was significantly affected by level of dam nutrition in mid-gestation (1.046 ± .03 vs 1.138 ± .03 kg/d, HN and LN respectively; $P<0.05$). Restricted suckling resulted in a 13 kg difference ($P<0.001$) between NS and RS calves at the end of the treatment after adjusting for liveweight at the beginning (Table 2). At weaning, RS calves were 10% lighter than NS calves. No significant interactions were detected between the main effects on liveweight of calves.

Observations made on cows and calves during and after the period of nose plate attachment suggested no major signs of distress in the calves. One calf lost its nose plate during the night of the second day, but it was replaced early next morning. Before fitting nose plates, there was no difference in behaviour between NS and RS calves (Table 3). Calves with nose plates on made repeated but unsuccessful attempts to suckle their mothers but the nose plates appeared to physically prevent calves sucking from the teats. Differences in calf behaviour were apparent 40 to 48h after fitting nose plates when RS calves spent less time idling and more time grazing than NS calves. The time spent grazing and suckling was greater for RS calves than NS calves at approximately 24, 72 and 120h after the nose plates were removed (Table 3). No problems were encountered with mothering up following restricted suckling treatment. There was no mastitis or any other disease noted as a consequence of suckling restriction.

In the ovaries one or more follicles larger than 10 cm were observed in 90.5% of the herd at 25 days *post partum* and in the remaining animals by 32 days. In all animals changes in the size of the large follicle and dominant to other follicles indicated a pattern of growth and atresia occurred before the first ovulation. As ultrasonography was conducted only at weekly intervals it was not possible to determine the number of cycles of follicle growth that occurred prior to first ovulation, but in each heifer the dominant follicle recorded prior to day 32 was not the one which resulted in ovulation.

No cow developed a corpus luteum (observed by ultrasonography) or showed a rise in progesterone concentration prior to suckling restriction at day 46 *post partum*.

Recording of day of first oestrus based on observations of tail paint removal from the cows or observation of mating by the bulls was not sufficiently accurate to determine main treatment effect. Errors in recording of oestrus in some cows

TABLE 1: Effect of nutritional treatment in pregnancy on liveweight (LW) (kg) and body condition score (BC) of cows.

	Groups[1]		Significance
	HN	LN	Level
Initial LW (March 10)	425 ± 1	427 ± 1	ns
Final LW (June 18)	499± ± 3	444 ± 3	***
LW Gain (kg/d)	0.75 ± .03	0.17 ± .03	***
BC (June)	3.9 ± 0.2	3.2 ± 0.2	*
Pre-partum LW	467 ± 14	415 ± 13	*
Post-partum LW	414 ± 10	356 ± 9	***
BC at calving	2.6 ± 0.1	2.1 ± 0.1	*
LW at weaning	476 ± 11	432 ± 11	*
BC at weaning	3.2 ± 0.1	3.1 ± 0.8	ns

[1] HN = High Nutrition; LN = Low Nutrition.

TABLE 2: Effect of suckling treatment on liveweight (LW) and liveweight gain (LWG) of calves (kg and kg/day).

Parameter	Groups[1]		Significance
	NS	RS	Level
LWG from calving to treatment	0.96 ± .04	0.92 ± .03	ns
LW at onset of treatment	77.1 ± 1.6	75.7 ± 1.7	ns
LW at end of treatment	85.0 ± 1.9	70.5 ± 2.0	***
LWG during treatment	1.12 ± .10	-0.75 ± .10	***
LW 3 days after treatment	86.6 ± 1.6	72.3 ± 1.7	***
LW at weaning	162.4 ± 2.9	146.7 ± 3.1	**
LWG from end of treatment to weaning	1.31 ± .05	1.30 ± .06	ns
Overall LWG from calving to weaning	1.16 ± .03	1.02 ± .03	**

[1] RS = Restricted Suckling; NS= Normal Suckling.

TABLE 3: Effect of suckling restriction by fitting nose plates to calves on time (min) spent idling, grazing, suckling and attempting to suckle from 0600-0900 h on selected days.

Time of Observation (Hours[2])	Calf Behaviour: Idling[1] RS	Idling[1] NS	Grazing[1] RS	Grazing[1] NS	Suckling[1] RS	Suckling[1] NS	Attempts[1] RS
Prior to Treatment							
-72	104 ± 7^{b}	117 ± 7^{bc}	37 ± 6^{abfg}	27 ± 6^{adfg}	19 ± 3^{abc}	16 ± 3^{acd}	-
-24	129 ± 7^{cde}	134 ± 7^{cdef}	20 ± 6^{ad}	22 ± 6^{adf}	31 ± 3^{bf}	24 ± 3^{abf}	-
During Treatment							
24	$93 + 7^{b}$	108 ± 7^{b}	47 ± 6^{bfg}	49 ± 6^{bfg}	-	13 ± 3^{cdg}	30 ± 2^{a}
48	85 ± 7^{ab}	129 ± 7^{cde}	71 ± 6^{c}	22 ± 6^{adf}	-	17 ± 3^{dg}	12 ± 2^{b}
72	67 ± 7^{a}	142 ± 7^{cdef}	86 ± 6^{c}	17 ± 6^{d}	-	10 ± 3^{dg}	20 ± 2^{c}
96	107 ± 7^{b}	136 ± 7^{cdef}	69 ± 6^{c}	34 ± 6^{adfg}	-	10 ± 3^{dg}	3 ± 2^{d}
120	92 ± 7^{b}	146 ± 7^{ef}	84 ± 6	24 ± 6^{adf}	-	10 ± 3^{dg}	3 ± 2^{d}
After Treatment							
+24	110 ± 7^{b}	143 ± 7^{ef}	44 ± 6^{g}	25 ± 6^{adf}	27 ± 3^{f}	11 ± 3^{dg}	-
+72	104 ± 7^{b}	154 ± 7^{f}	57 ± 6^{cg}	14 ± 6^{d}	19 ± 3^{df}	12 ± 3^{dg}	
+120	102 ± 7^{b}	138 ± 7^{def}	62 ± 6^{c}	38 ± 6^{fg}	16 ± 3^{df}	5 ± 3^{g}	-

[1]RS= Restricted Suckling; NS= Normal Suckling.

[2]Hours before the beginning of (-), during or after (+) suckling treatment.

[abcdefg]Means within behaviour classes and between treatments which have superscripts with letters in common are not significantly different (P>0.05).

became evident once the age of the embryo was determined after slaughter.

The mean intervals from calving to conception in the RS groups were 67.3 ± 8 days (HN) and 84.8 ± 8 days (LN) and in the NS groups, 102.0 ± 9 days (HN) and 86.3 ± 8 days (LN), respectively (P<0.05). Neither the genotype of the dam or the level of nutrition in mid-pregnancy had an effect on the interval to conception.

DISCUSSION

Prolonged resumption of ovarian cyclic activity in primiparous HF and HS heifers was due to lack of ovulation rather than delayed development of a dominant follicle. These findings are in agreement with those reported by other authors (Murphy *et al.*, 1990; Roche *et al.*, 1992). The present findings are also consistent with the pattern of ovarian activity reported for mixed age and breed type of lactating New Zealand dairy cows (McDougall and Macmillan, 1993) and in single- and twin-suckled HxF adult cows at Ruakura (W.H. McMillan, pers. com.). The results of the present study also confirmed the observation reported in many trials that large follicles are present in the ovaries of suckled beef cows early in the post-partum period (Murphy *et al.*, 1990; Roche *et al.*, 1992). The nutritional levels imposed on heifers in mid-gestation did not affect either the occurrence of dominant follicles after day 25 *post partum* or the size of the largest follicle. Perry *et al.* (1991) found, however, that adult cows receiving restricted levels of energy four months before calving did not develop dominant follicles up to 46 days after calving. Heifers calved in better body condition in the present experiment.

The extra feed received by HN cows in mid-gestation did not improve their re-breeding performance. The nutritional level in mid-gestation tended to influence the effect of restricted suckling treatment, which is consistent with other authors (Holness *et al.*, 1978; Dunn *et al.*, 1983). Those authors reported that better responses in reproductive performance to restricted suckling are obtained when cows are in moderate to high body condition rather than in a low condition. The reasons for this interaction are not clear. Some have tried to explain those variable responses to temporary weaning by suggesting that responses might be related to the amount of follicular development at the time of suckling restriction (Dunn *et al.*, 1985). However, this explanation is not consistent with the observation in this trial that there was no difference among groups in the occurrence of dominant follicles or size of largest follicle prior to the imposition of restricted suckling. In spite of substantial improvement in reproductive performance when suckling was restricted in HN cows, the development of follicular structures did not differ in the HN and LN cows.

The lower calf liveweight at weaning induced by restriction of suckling found in the present trial was reported by other authors as an obstacle to this management practice being adopted on commercial farms (Tervit *et al.*, 1982). However, RS cows should if re-bred earlier than NS cows produce calves earlier in the next season and because of more days for calf growth make up for suckling restriction liveweight losses. Further work is required to determine whether potential catch-up gains could be achieved. The cost of nose plates is minimal and they can be used for many years.

CONCLUSIONS

Restricted suckling by fitting nose plates to calves may be effective in shortening the interval from parturition to conception by about 2 weeks in first-calving beef cows calved in good body condition. This practice decreases calf liveweight at weaning by 10% but the daily liveweight gain after the restricted suckling treatment is not impaired. The calf liveweight loss during suckling restriction may well be offset in the following season with dams having older and heavier calves, a result of a more concentrated calving pattern achieved with RS cows.

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