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Effect of pre- and postpartum pasture feeding intakes on postpartum anoestrous intervals in dairy cows

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ABSTRACT

Extended postpartum anoestrous intervals (PPAI) are the predominant source of infertility on New Zealand dairy farms. A 2 x 2 factorial design was used to investigate pre- and postpartum pasture feeding levels on PPAI. Sixty-eight multiparous Holstein-Friesian dairy cows due to calve in the first three weeks of the calving period were randomly assigned to a high (11.9 kg DM/cow/day) or low (4.8 kg DM/cow/day) pasture feeding intake for 29 ± 7.7 days pre partum. After calving, cows within each prepartum feeding level were assigned to a high (13.5 kg DM/cow/day) or low (8.6 kg DM/cow/day) pasture feeding intake for 35 days. At 35 days post partum, cows were grazed as a single group with pasture silage supplementation. Concentrations of progesterone were determined in milk samples collected on Mondays and Thursdays until cows were confirmed to have resumed oestrous cycles or until one week before planned start of mating. High intakes pre-calving increased ($P < 0.05$) the proportion of cows cycling by the third week postpartum (38 ± 8%) compared with a low pre-calving intake (13 ± 6%). There was a tendency ($P = 0.07$) for a reduced mean PPAI in the high (29.7 ± 2.6 days) versus low (33.4 ± 2.3 days) pre-calving intake treatments, among cows that initiated oestrous cycles during the experimental period. Post-calving intake did not affect PPAI ($P = 0.4$), nor was an interaction detected. Body condition score (BCS) at all time points in this study, including before treatments were initiated, was negatively correlated with PPAI ($P < 0.05$). In contrast, PPAI was not associated ($P > 0.1$) with changes in BCS during the pre- or post-calving periods, or with milk production characteristics. In this study, resumption of oestrous cycling post partum was strongly linked to pre-existing differences in BCS, and modified by pre-calving pasture intake, but not influenced by feeding intakes or milk production characteristics in early lactation.

Keywords: anoestrus; nutrition; dairy cow.

INTRODUCTION

Extended postpartum anoestrous intervals (PPAI) are a major risk factor of poor reproductive performance in seasonal dairy systems. Numerous studies have reported on factors that influence the PPAI (see review by Rhodes *et al*., 2003). These factors can be features of the animal such as age, breed and genotype; features of the farm system, especially stocking rates and feeding levels (McDougall *et al*., 1995a); and, interactive factors such as body condition of the animals (Tunon *et al*., 2004). Animals calving in a poor body condition and having an extended period of negative energy balance in early lactation are at greatest risk for having a prolonged PPAI (see Rhodes *et al*., 2003).

The importance of adequate nutrition prior to calving on minimising PPAIs has been demonstrated in a number of studies, especially for younger stock (Burke *et al*., 1995; Chagas *et al*., 2001). Much less attention has been given to postpartum nutrition on PPAI, although McDougall *et al.* (1995b) reported no reproductive benefit to increasing feed intake and milk production with supplementation during the first month of lactation. There are no controlled studies to our knowledge about the effects of transitional pasture feeding intakes on reproductive performance. Accordingly, the hypotheses were tested that: (a) PPAI in mature cows is influenced by level of pasture intake three weeks before calving and; (b) this effect is modified by level of pasture feeding in early lactation.

MATERIALS AND METHODS

Sixty-eight multiparous Holstein-Friesian cows were assigned to have a low pasture intake (Low-pre; 5 kg DM/day; n = 34) or a high pasture intake (High-pre; 12 kg DM/day; n = 34) beginning 29 ± 7.7 days before actual calving date. These cows were selected on the basis of being due to calve within 21 days from the planned start of calving (9 July 2004). During the postpartum period, half of the cows within each prepartum feeding treatment were allocated to have a low pasture intake (Low-post; 10 kg DM/day) or a high pasture intake (High-post; 15 kg DM/day) for 35 days. At 35 days post partum, all cows were grazed as one group and supplemented with pasture silage. The design was a 2 x 2 factorial arrangement with 17 replicates per treatment cell.

A companion paper in this proceedings (Roche *et al.*, 2005) details the methodology of grazing management, measurements of feed consumption and milk production characteristics. Briefly, pre- and post-grazing herbage masses and grazing area allocations were used to control average pasture intakes for cows within treatments. Individual milk yields were measured at each milking and compositional characteristics were determined twice weekly for 35 days post partum.

Individual live weight and body condition score (BCS) were measured weekly throughout.

Progesterone was measured in a composite of milk samples collected at the Monday afternoon-Tuesday morning and Thursday afternoon-Friday morning milkings of each week until cows were confirmed as cycling. Progesterone was measured using an ELISA kit (Ridgeway Sciences, Gloucestershire, United Kingdom) validated for use in cattle (Sauer *et al*., 1986). The PPAI was defined as the interval from calving to first day that the concentration of progesterone increased to at least 3 ng/ml with subsequent concentrations being consistent with oestrous cycling. The PPAI was not determined in six cows which showed no signs of oestrous cycling activity by 51 to 77 days postpartum, at which point they were treated for anoestrus with a CIDR. Premating oestrous activity and AI dates on detected oestrus were recorded by farm staff using visual observations aided by the tail painting technique (Macmillan *et al*., 1988).

Data were analysed by general linear model ANOVA using REML in Genstat 5.4.1 with effects of treatment in a 2 x 2 factorial arrangement being fixed and cow as a random effect. Data of two cows were excluded from general analyses having been removed from the trial during the first 35 days postpartum. Another two cows were culled at the start of mating and were excluded from the mating performance observations. Data are presented as the mean ± SEM.

RESULTS

Feeding treatments on postpartum anoestrous intervals (PPAIs)

Initiation of postpartum oestrous cycles tended ($P = 0.07$) to occur sooner for cows on the high prepartum intakes (29.7 ± 2.6 days) as compared with low prepartum pasture intakes (33.4 ± 2.3 days), with a greater ($P < 0.05$) proportion of cows having ovulated by three weeks post partum (Figure 1; 38 ± 8% and 13 ± 6%, respectively). The proportion of animals that were still anoestrus by seven weeks post partum (18%) was similar between these treatment groups. Postpartum feeding treatments did not affect PPAI, nor was there a detectable interaction between the pre- and postpartum treatments on PPAI (Table 1).

Age, BCS and milk production on PPAI

The PPAI was shorter ($P < 0.05$) in four-year-old cows (25.4 ± 2.5; n = 19) as compared with three-year-olds (39.4 ± 3.5; n = 24) and those five years old or greater (37.0 ± 3.6; n = 23). Body condition score influenced ($P < 0.05$) PPAI with each 0.5 BCS increase being associated with a reduction of 4 days in PPAI. A significant and consistent relationship between BCS and PPAI was evident for all measured time points, including the period immediately before treatments were initiated. Even so, BCS accounted for only 5 to 12% of the variance in PPAI (Figure 2). Live weight influenced PPAI (data not shown) in a similar manner to BCS, although the strength of the relationship was not as strong as it was with BCS. The PPAI was not related ($P > 0.1$) to milk solids, net energy of lactation (NE_L), protein % or protein yield during the first six weeks of lactation (Table 1).

FIGURE 1: Proportion of anovular cows as a function of time post partum for low (Low-pre) and high prepartum pasture intake treatments. Data are pooled across postpartum feeding treatments. Asterisks denote difference ($P < 0.05$) between treatments.

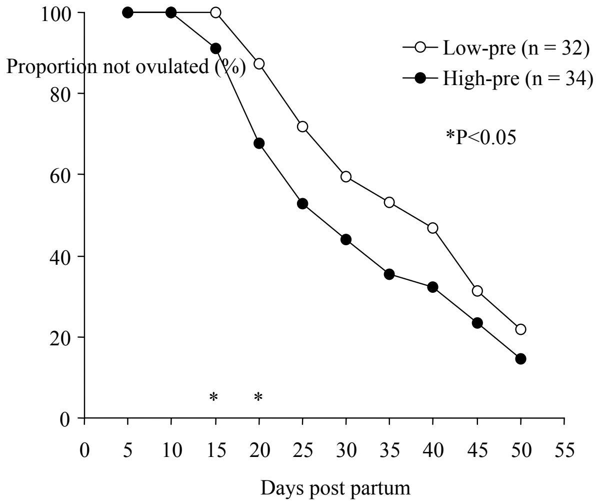


TABLE 1: Body condition score (BCS), live weight, milk production characteristics and post partum anoestrous intervals (PPAI) in mature Holstein-Friesian cows with low or high pre-calving pasture intakes followed with low or high pasture intakes in early lactation.

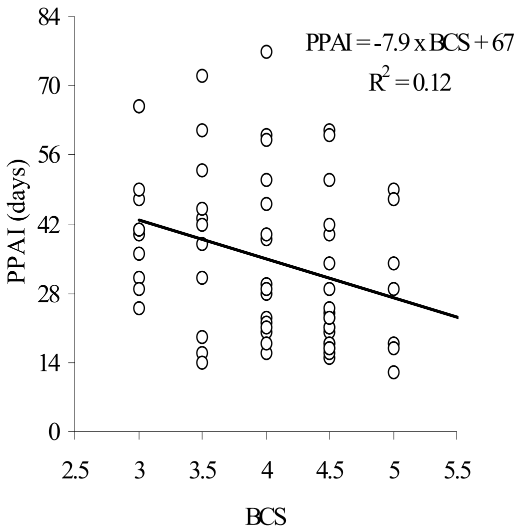
	Low-Low	**Low-High**	**High-Low**	**High-High**
No. cows	15	17	17	17
Calving BCS (Scale 1 to 10)	4.0 ± 0.1	4.3 ± 0.1	4.9 ± 0.2	4.6 ± 0.2
[1]Calving live weight (kg)	518 ± 17	500 ± 13.4	572 ± 17	550 ± 14
[2]MS (kg/day/cow)	1.54 ± 0.06	1.87 ± 0.05	1.58 ± 0.09	2.14 ± 0.09
[2]NE_L (MJ/cow/day)	65.1 ± 2.4	78.0 ± 1.9	66.6 ± 4.1	88.9 ± 3.6
[2]Protein (kg/day/cow)	0.66 ± 0.03	0.83 ± 0.02	0.65 ± 0.04	0.93 ± 0.04
[2]Protein %	3.39 ± 0.04	3.53 ± 0.04	3.46 ± 0.06	3.62 ± 0.06
PPAI (days)	34.7 ± 3.7	32.1 ± 2.8	29.2 ± 3.6	30.3 ± 4.0

[1]Measured one to nine days before calving
[2]Daily average during first six weeks of lactation
MS = milksolids
NE_L (net energy of lactation; MJ/cow)
= (0.0929 x fat %) +
(0.0547 x crude protein %) + (0.0395 x lactose %)
x 4.186 MJ/Mcal x kg milk/cow

Anoestrus, insemination and conception rates

The majority of cows spontaneously cycled (91%) and were observed in oestrus (74%) before the date for planned start of mating (1 October 2005), and subsequently inseminated on detection of oestrus within the first 28 days (95%) of the mating period. The 49-day non-return rate was 69%, this being an indication of conception rates to first insemination and defined in this study as proportion of cows inseminated by the 23rd day of mating and not having a return AI by the 49th day of mating. The 49-day non-return rates were similar for High-pre (68%) as compared with Low-pre (70%); and High-post (67%) as compared with Low-post (71%) treatment groups.

FIGURE 2: Association between body condition score (BCS) at calving and postpartum anoestrous interval (PPAI) across all cows.



DISCUSSION

The PPAI of cows in this study was somewhat unresponsive to pasture feeding intakes during the transition period. Prepartum level of feeding influenced PPAI to some extent, but postpartum feeding had no impact on PPAI. The factor that had the greatest influence on PPAI was BCS, and at most time points including pre-existing BCS. Even so, BCS only explained about 12% of the variance in PPAI. Unaccounted for differences among individuals remained the largest source of variation. These findings imply that managerial strategies that maintain recommended target BCS at calving (BCS 5 for mature cows), coupled with animal selection strategies to identify and avoid cows with long PPAIs, are avenues for accelerating the onset of oestrous cycling after calving in multiparous Holstein-Friesian cows.

High prepartum feed intakes accelerated the onset of postpartum ovulation, although the difference was only 3 to 4 days as compared with the low prepartum intake treatment; and the benefit of high prepartum intake was not significant beyond the first three weeks postpartum. Postpartum intake did not influence PPAI in this study. This pattern of response is similar to that previously reported in first calving Holstein-Friesian heifers (Burke *et al*., 1995; Chagas *et al.,* 2001). These previous studies demonstrated that the negative impact of restricted feeding pre partum in heifers is not overcome by generous feeding after calving (Burke et al., 1995), but can be ameliorated when high levels of feeding are offered during the six weeks before calving (Chagas *et al*., 2001). Several other studies support these findings that improved prepartum nutritional status leading to improved BCS at calving is the main determinant of PPAI in cattle (McDougall, 1994; Stagg *et al*., 1998). In cases where dry matter energy intakes have been significantly associated with the prevalence of anoestrus (McDougall *et al*., 1995a; Rhodes and Morgan, 1999), the duration of intake differences were chronic in nature, and probably acting through changes in general BCS as evidenced in the present study.

None of the milk production characteristics analysed for the first six weeks of lactation was significantly associated with variation in PPAI, which is consistent with previous findings that breeding worth, production worth and milk production were not related to prevalence of anoestrus (Rhodes *et al*., 1998; Rhodes and Morgan, 1999). Several reports show evidence of a positive association between milk protein content and reproductive performance (Buckley *et al*., 2003; McDougall, 2003). However, a significant relationship between protein % (or yield) and PPAI was not found in the present study.

A greater numbers of animals would have been necessary to test statistically the effects on transition pasture intakes on general reproductive performance. However, we consider it pertinent to report the nominal results of a mating performance equivalent to, or better than, industry targets. From these observational data, there was no evidence that restricted pasture intakes during the transition period perturbed the mating outcome. This outcome was likely a consequence of confining the study to mature, early-calving cows with good feeding from 35 days post partum through mating. Reproductive problems are less prevalent in these types of cows under these circumstances (McDougall *et al*., 1995a; Hayes, 1997; Rhodes *et al*., 1998; Tuñon *et al*., 2004). The benefits of reducing PPAI would only be realised if poor reproductive performance can be attributed to an anoestrous problem in the herd.

In conclusion, PPAI in mature Holstein-Friesian cows was remarkably unresponsive to extremes in pasture intakes during the transitional calving period. Restricted pasture intakes pre partum increased PPAI by a few days, but postpartum pasture intakes had no effect. Strategies to reduce the length of anoestrus in mature cows need to address a broader timeframe than the transition period. A general lift in BCS of the herd, coupled with longer-term genetic selection strategies for avoidance of cows with prolonged PPAI, should be considered as the most viable approach to alleviating an anoestrous problem in mature cows.

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