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## Effects of breed and calving liveweight on postpartum ovarian activity in pasture-fed dairy heifers

C.R. BURKE, S. McDOUGALL AND K.L. MacMILLAN

Dairying Research Corporation, Private Bag 3123, Hamilton, New Zealand.

### ABSTRACT

This study endeavoured to characterise the effects of breed and calving liveweight (CW) on postpartum (pp) ovarian activity in 16 Friesian (F) and 16 Jersey (J) heifers. Half of the animals within each breed were differentially fed (High vs Low: H vs L) during the 8 weeks before calving to achieve CWs (24 h pp) of 404 (FH), 354 (FL), 334 (JH) and 279 (JL) kg. They were fully fed as one group after calving. Ovarian ultrasonography showed that the FL group had the longest postpartum anovulatory interval (PPAI) of 77 days compared to 47 days among other groups. The second dominant follicle pp emerged 6 days later in FL heifers. Breed, but not CW, affected follicle patterns in the first normal oestrous cycle. Underfeeding of Friesian heifers during late pregnancy extended the PPAI whereas Jerseys were not affected to the same extent.

**Keywords:** postpartum dairy heifer; breed; calving liveweight; ovarian activity.

### INTRODUCTION

The major form of infertility among dairy cows in New Zealand is a prolonged postpartum anovulatory interval (PPAI) to first ovulation. This can delay the date of first insemination and conception, extending the calving interval and reducing the length of the subsequent lactation (Macmillan and Clayton, 1980). Breed, nutrition and age are factors which influence the PPAI. Friesians (F) tend to have a greater PPAI compared to Jerseys (J) (Fonseca *et al.*, 1983), particularly when under nutritional stress (McDougall *et al.*, 1995b), and heifers may take 2 weeks longer to commence ovulating than older animals. Trans-rectal ultrasounding has established that large ovarian follicles are present and active from around 11 days postpartum (pp) in pasture-fed dairy cows, even in those with a prolonged PPAI (McDougall *et al.*, 1995a). The present study aimed to characterise the effects of calving liveweight on ovarian activity during the postpartum period in Friesian and Jersey heifers.

### MATERIALS AND METHODS

Sixteen F and 16 J heifers of high genetic merit conceived to first insemination in a synchronised mating programme. Pasture feed allowance was restricted in 8 animals (L) of each breed during the 8 weeks before the common due calving date of 15th July 1993, compared to fully fed contemporaries (H). The calving liveweight (CW) was recorded within 24 h pp, and then fortnightly for each heifer. After calving, all heifers were managed as a single herd and were offered a generous allowance of pasture.

The ovaries of each animal were examined by trans-rectal ultrasonography from 7 days pp until an oestrous cycle of normal duration (ie 18-25 days) had been completely monitored. All follicular and luteal structures greater than 3 mm in diameter were sketched and the video image recorded on cassette. Initiation of an ovarian follicle wave was defined as the day on which a large dominant follicle (>8 mm) was

retrospectively traced to being 4-5 mm in diameter. Animals were observed twice daily for any behavioural symptoms of oestrus and also monitored using the tailpainting technique.

Composite subsamples of milk were analysed for milk fat and protein concentrations on a fortnightly basis (Milkoscan, N.Foss Electrical, Denmark). Additional milk samples were collected 3 times weekly to monitor progesterone concentrations (Coat-a-Count, DPC, California, USA) and to consequently confirm the occurrence of ovulation.

The data were analysed by analysis of variance and Fisher pairwise comparison procedures using the Minitab V8.2 statistical package. Data are expressed as the mean  $\pm$  sem.

### RESULTS

All heifers calved within a 14 day period about a mean date of 15th July 1993 ( $\pm 0.6$  days), although Fs calved 3 days earlier than J heifers ( $p < 0.05$ ). Calf weight at birth was dependent on breed (F:  $34.5 \pm 0.9$  kg; J:  $25.4 \pm 1.0$  kg;  $p < 0.05$ ), but not on CW within breed ( $p > 0.1$ ).

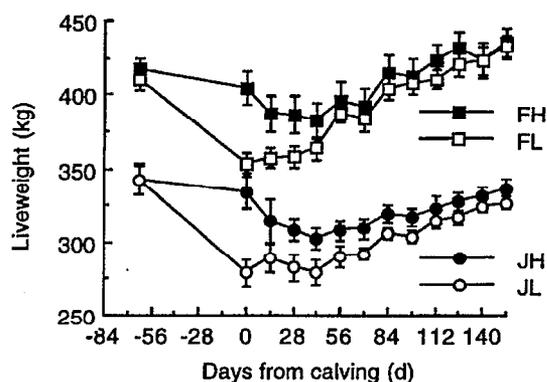
The CWs of FH and JH heifers were 50 and 55 kg heavier than those in FL and JL groups, respectively (breed and treatment;  $p < 0.05$ ; Table 1). During the first 6 weeks of lactation, L heifers gained  $6 \pm 4$  kg whereas H heifers lost  $27 \pm 5$  kg (treatment;  $p < 0.05$ ; Fig. 1). Liveweight gains continued to be higher for L groups in the following 6 weeks ( $34.4 \pm 3.2$  vs  $24.8 \pm 3.2$  kg;  $p < 0.05$ ), but more so for F than J heifers ( $36.3 \pm 2.7$  vs  $21.1 \pm 3.0$  kg;  $p < 0.05$ ). Heifers of L groups produced 11% less milksolids (MS) over the first 9 weeks of lactation compared to those in H groups ( $1.01 \pm 0.05$  vs  $1.15 \pm 0.03$  kg MS/d, respectively;  $p < 0.05$ ). From 9 weeks postpartum, there were no significant treatment effects on absolute liveweights or MS production.

The intervals from calving to first ovulation and first detected oestrus were longest in the FL group compared to equivalent intervals among other groups (breed  $\times$  treatment;  $p < 0.05$ ; Table 1). Number of follicle waves (including the

**TABLE 1:** Mean ( $\pm$  sem) liveweight within 24 h postpartum (CW), intervals (days) from calving to first ovulation (OV1) and first detected oestrus (H1) postpartum and the number of follicle waves before first ovulation (ranges in brackets) in Friesian (F) and Jersey (J) heifers which calved at high (H) or low (L) liveweights.

Group	n	CW (kg)	Intervals (days) from calving to:		No. follicle waves to OV1
			OV1	H1	
FH	8	404 $\pm$ 12 <sup>a</sup>	50.8 $\pm$ 8.9 <sup>a</sup> (22-88)	62.0 $\pm$ 8.4 <sup>a</sup> (31-96)	5.4 $\pm$ 1.1 <sup>a</sup> (2-11)
FL	8	354 $\pm$ 7 <sup>b</sup>	76.5 $\pm$ 8.3 <sup>b</sup> (43-115)	85.3 $\pm$ 9.6 <sup>b</sup> (53-136)	8.3 $\pm$ 1.1 <sup>b</sup> (4-12)
JH	8	334 $\pm$ 11 <sup>b</sup>	46.0 $\pm$ 7.4 <sup>a</sup> (18-78)	55.3 $\pm$ 8.3 <sup>a</sup> (28-91)	4.9 $\pm$ 1.1 <sup>a</sup> (1-10)
JL	6	279 $\pm$ 9 <sup>c</sup>	42.5 $\pm$ 3.1 <sup>a</sup> (34-51)	60.0 $\pm$ 2.8 <sup>a</sup> (51-70)	4.4 $\pm$ 0.2 <sup>a</sup> (4-5)

**FIGURE 1:** Mean ( $\pm$  sem) liveweights of Friesian (F) and Jersey (J) heifers which calved at high (H) or low (L) liveweights. Liveweights at Day 0 are within 24 h postpartum.



Most F heifers (13 of 15) had 2 ovarian follicle waves per cycle (2-wave) as compared to 3 follicle waves (3-wave), whereas J heifers had a similar number of each type (5:7;  $p < 0.05$ ). Two-wave cycles were 3 days shorter than those with 3 follicle waves (2 vs 3-wave:  $19.2 \pm 0.2$  vs  $22.4 \pm 0.5$  days;  $p < 0.05$ ), and Fs tended to have shorter length cycles than J heifers ( $19.7 \pm 0.4$  vs  $21.1 \pm 0.6$  days;  $p = 0.07$ ). The first dominant follicle (DF1) in Fs attained a larger maximum diameter ( $15.0 \pm 0.3$  mm) and at a later stage of the cycle (Day  $8.4 \pm 0.4$ ) compared to J heifers ( $12.9 \pm 0.3$  mm and Day  $6.6 \pm 0.3$ ;  $p < 0.05$ ). Treatment did not influence development features of the DF1.

**DISCUSSION**

A novel aspect of this study is the direct comparison of ovarian follicle dynamics in pasture-fed F and J heifers calving at contrasting liveweights. Extended PPAIs in the FL heifers were associated with a delayed development of the DF2pp and a greater number of successive anovulatory follicle waves prior to first ovulation. CW of Js did not affect the PPAI, but did influence the diameter of the DF2pp. Follicular patterns during the first pp oestrous cycle of normal length differed between breeds, but were independent of calving liveweight within breed.

Liveweight gains were positive for FL heifers during the first 6 weeks of lactation, whereas those calving at higher CWs lost weight during this period. In cows genetically selected for high milk production, such as the heifers of the present study, energy balance (EB; the difference between dietary energy intake and energetic output) is typically negative (NEB) during early lactation. Body reserves are mobilised to maintain higher milk yields. The extent and duration of NEB influences PPAI (Canfield and Butler, 1990). By definition, cows with static or increasing liveweight cannot be subjected to a significant NEB. The extended PPAI in FL heifers which had the greatest liveweight gains during early lactation, reveals the importance of CW on subsequent reproductive events. Since ovarian activity is largely dependent on pituitary gonadotrophins (FSH and LH), the effects of CW on follicular pattern are likely to be mediated via the hypothalamic-pituitary axis.

The follicular patterns of the first normal cycle in F heifers were predominantly of the 2-wave type compared to an equal proportion of 2 and 3-wave in Js. Two-wave cycles are inherently shorter than the 3-wave ones (Sirois and Fortune, 1988), as was the case in the present study. The first oestrous cycle of normal duration was consequently shorter in F compared to J heifers. The larger DF1 in F heifers with

ovulatory follicle) preceding first ovulation was highly correlated ( $R^2 = 92.5\%$ ) with PPAI. Each group had at least one heifer with intervals from calving to first ovulation and first detected oestrus of at least 50 and 70 days, respectively.

Mean day of emergence of the second dominant follicle postpartum (DF2pp) was later in FL heifers ( $16.6 \pm 1.2$  days) compared to the other groups ( $11.4 \pm 0.5$ ;  $p < 0.05$ ; Table 2). Treatment, but not breed, influenced the size of the DF2pp where maximum diameter was greater in H ( $13.9 \pm 0.5$  mm) compared to L heifers ( $12.3 \pm 0.3$  mm;  $p < 0.05$ ). There were no breed or treatment effects on the interval between emergence of the DF2pp and DF3pp ( $8.9 \pm 0.5$  days).

Following first ovulation, every heifer had a short oestrous cycle ( $9.2 \pm 0.2$  days) with a single follicle wave. This short cycle was immediately followed by an oestrous cycle of normal length (range; 18-25 days). The exception was a single JL heifer with 2 short cycles preceding a cycle of normal duration. First ovulation was rarely accompanied with an overt oestrous display (13%) compared to the second (87%) and third (100%) ovulations.

**TABLE 2:** Mean Day ( $\pm$  sem) of emergence, maximum diameter and Day of maximum diameter of the second dominant follicle in postpartum Friesian (F) and Jersey (J) heifers which calved at high (H) or low (L) liveweights (Day 0 = Day of calving).

Group	n	Day of emergence	Maximum diameter (mm)
FH	8	10.9 $\pm$ 0.8 <sup>a</sup>	13.6 $\pm$ 0.6
FL	8	16.6 $\pm$ 1.2 <sup>b</sup>	12.8 $\pm$ 0.3
JH	7	11.4 $\pm$ 0.8 <sup>a</sup>	14.1 $\pm$ 0.8
JL	5	12.0 $\pm$ 1.2 <sup>a</sup>	12.0 $\pm$ 0.4

its longer growing phase may have predisposed these animals to a predominance of 2-wave cycles.

In conclusion, restricted feeding during late pregnancy will increase the incidence of a prolonged PPAI, especially in F heifers of high genetic merit. A sole diet of pasture during early lactation is not sufficient to overcome these effects.

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