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Effect of calving liveweight on milk yield and composition and daily dry matter intake in Friesian and Jersey heifers

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ABSTRACT

Milk yield and composition were measured weekly throughout lactation, and daily dry matter intake (DMI) on 7 occasions, for Friesian (n=16) and Jersey (n=16) heifers calving at either high (H) or low (L) liveweights. During the 8 weeks pre-partum, heifers were fed to achieve calving liveweights of 404 (H Friesian), 354 (L Friesian), 334 (H Jersey) and 277 (L Jersey) kg. All heifers were fully fed on pasture as one group for the whole of lactation.

Calving liveweight had no effect on average DMI over the season. Average DMI was higher for Friesians than Jerseys while average liveweight-corrected DMI was slightly greater for Jersey than Friesians. Average daily milk yields and yields of lactose were lower for L than H heifers. Solids-corrected milk yields and yields of milkfat and protein were unaffected by calving liveweight, but milkfat % and protein % were higher for L than H heifers. The Friesians had higher milk yields, and yields of protein and lactose, but lower milkfat % and protein % than Jerseys.

No effect of restricted feeding during late pregnancy in heifers was demonstrated on milk solids production in the subsequent lactation.

Keywords: Calving liveweight; heifer; n-alkanes; dry matter intake; milk.

INTRODUCTION

Greater body condition at calving can lead to increased milk solids production during the subsequent lactation, and a reduction in voluntary dry matter intake (DMI) in pasture-fed cows. This is because cows calving in good condition are able to partition stored body energy into milk production at the expense of liveweight gain, while cows calving in thin condition have less body reserves and must eat more to compensate (Rogers *et al.* 1979; Grainger *et al.* 1982).

The aim of the current study was to demonstrate the effect of calving liveweight on milk production and DMI, using the alkane technique for the determination of individual DMI of free-grazing heifers over the entire lactation. Heifers were chosen for study because Macmillan *et al.* (1982) and Thomson *et al.* (1991) observed that the effects of calving liveweight on subsequent production were greater for 2 and 3 year old cows than for older cows.

MATERIALS AND METHODS

Fifteen month old Friesian (n=16) and Jersey (n=16) heifers which had conceived on the same date in October 1993 (Burke *et al.* 1995) were used in the experiment. To achieve high (H) and low (L) calving liveweights, pasture allowance was restricted for 8 animals of each breed during the 8 weeks before the common expected calving date. The remaining 8 animals of each breed were fully fed on pasture. This feeding regime produced mean calving liveweights of 404 (H Friesian), 354 (L Friesian), 334 (H Jersey) and 277 (L Jersey) kg, and mean condition scores at calving of 4.8 (H Friesian), 4.5 (L Friesian), 4.5 (H Jersey) and 4.0 (L Jersey). Weekly liveweight and condition score measure-

ments were used to guide pre-calving feeding levels; pasture allowance assessments were made by grazing area measurements and visual pre- and post-grazing herbage mass estimates. Each animal's liveweight was recorded within 24 h post-partum, and fortnightly thereafter.

Once calved, all heifers were managed as a single herd through their lactation and were offered a generous pasture allowance to minimise any effects of competition between Friesians and Jerseys. Post-grazing herbage mass was monitored daily by visual estimation, and did not fall below 1,800 kg DM/ha; this should have allowed the heifers to express their appetites.

Individual DMI was measured using the alkane technique (Dove *et al.* 1988; Dove and Mayes 1991) during each of 7 periods during the season (6 during lactation and 1 during the dry period). The analytical procedures used to measure alkane concentrations were those described by Mayes *et al.* (1986) using an automated GLC (5890A; Hewlett-Packard, Avondale, PA).

Milk yield was measured weekly throughout the season (twice weekly during DMI estimation periods) using in-line milk meters. Samples from each heifer were analysed for milkfat, protein, and lactose with a Milkoscan 133B (Foss Electric, Denmark). Milk yield was converted to solids-corrected milk yield (SCM) using the equation of Tyrell and Reid (1965). Heifers were dried off when daily milk yields fell below 5 and 4 kg/cow/day, for Friesians and Jerseys respectively.

The statistical significance of differences was assessed by analysis of variance, using the general linear models procedure of SAS (SAS Version 6, SAS Institute Inc., Cary, NC, USA). The model included calving

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liveweight, breed, period, and the calving liveweight by breed interaction. The main effects of calving liveweight and breed were tested using between cow error terms.

RESULTS

Liveweight gain throughout lactation was greater for L than H heifers (Figure 1). During the first 56 days of lactation, H heifers lost liveweight (although H Jerseys lost more liveweight than H Friesians) while L heifers gained weight. No within breed differences in liveweight for H and L heifers existed 313 days after calving.

Average daily milk yield for the season was lower for L than H heifers (Table 1), while Friesians produced more milk on a daily basis than Jerseys. SCM, averaged over the season, was higher for Friesians than Jerseys, but was unaffected by calving liveweight. At the beginning of lactation (8 - 56 days since calving), however, SCM was significantly lower for L than H heifers (Figure 2). Friesians tended to have a higher SCM than Jerseys for approximately the first 200 days of lactation, but the effect of calving liveweight on SCM in early lactation was more pronounced for Jerseys than Friesians.

Daily milkfat and protein yields across the season were not significantly affected by calving liveweight, but lactose yields were lower for L than H heifers (Table 1). Friesians had a higher average daily protein and lactose yield for the season than Jerseys (Table 1). Mean protein and milkfat concentrations over the season were higher both for L than H heifers (Table 1), and for Jerseys than Friesians (Table 1).

DMI for all groups peaked at around 110 days since calving and were lowest in early lactation (Figure 3). Calving liveweight had no effect on mean daily DMI or liveweight-corrected DMI for the season. Friesians consumed more dry matter per day than Jerseys over the season (Figure 3), although when expressed as DMI per 100 kg of liveweight, Jerseys consumed slightly more dry matter than Friesians (Table 1).

FIGURE 1: Mean liveweight from 0 to 316 since calving for Friesian heifers calving at high (●) and low (○) liveweight and Jersey heifers calving at high (■) or low (□) liveweight. SED values between all treatment groups are shown above the X axis.

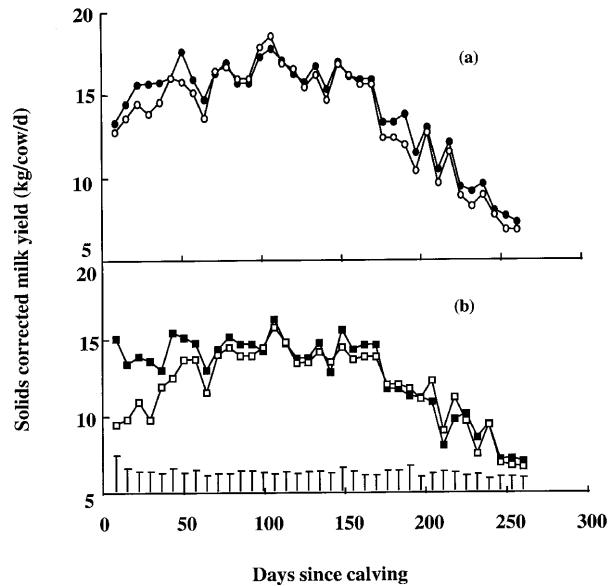


FIGURE 2: Solids-corrected milk yield across 260 day lactation for (a) Friesian heifers calving at high (●) or low (○) and (b) Jersey heifers calving at high (■) or low (□) liveweight. SED values between all treatment groups are shown above the X axis.

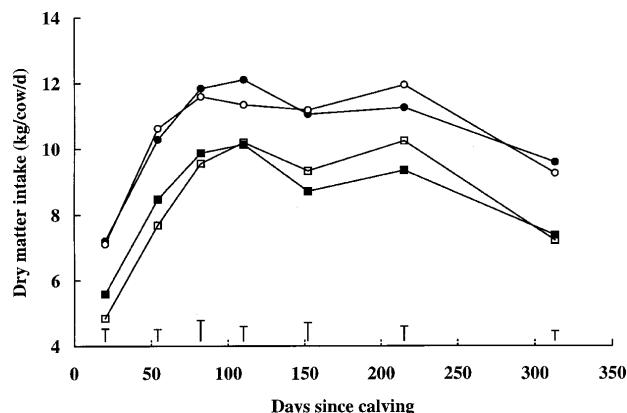
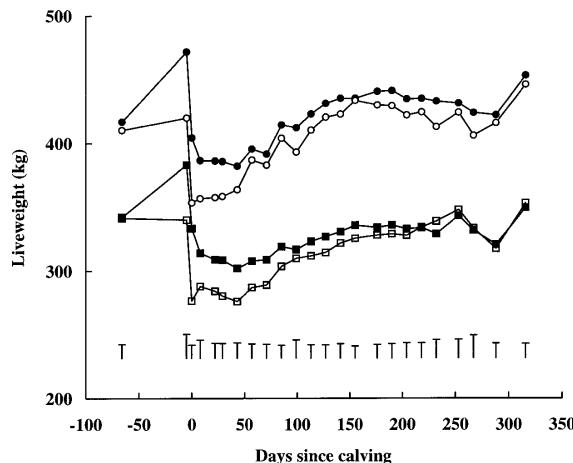


TABLE 1: Adjusted means for daily milk yield and composition and dry matter intake (DMI) measured across the lactation for Friesian (F) and Jersey (J) heifers of either high (H) or low (L) calving liveweight (CLW).

	H		L		SED	Main effects P<		
	F	J	F	J		CLW	Breed	Int ^d
DMI ^a	10.5	8.5	10.4	8.7	0.31	NS ^c	0.01	NS
DMI/100 kg LW	2.49	2.55	2.61	2.76	0.10	NS	0.05	NS
Milk yield ^a	13.6	10.7	12.5	8.9	0.88	0.03	0.01	NS
SCM yield ^b	14.1	13.1	13.6	12.1	0.77	NS	0.05	NS
Milk protein %	3.41	3.80	3.62	4.07	0.11	0.01	0.01	NS
Milkfat %	4.74	6.07	5.02	6.47	0.24	0.05	0.01	NS
Milk lactose %	4.80	4.94	4.89	4.93	0.07	NS	NS	NS
Protein yield ^a	0.46	0.40	0.45	0.36	0.03	NS	0.01	NS
Fat yield ^a	0.64	0.63	0.62	0.56	0.04	0.09	NS	NS
Lactose yield ^a	0.66	0.53	0.62	0.44	0.05	0.05	0.01	NS
Days in milk	257	232	257	247	0.05	NS	0.01	NS

^akg/cow/day. ^bSolids corrected milk yield. ^cNot significant (P>0.1). ^dCLW x breed interaction.

FIGURE 3: Daily dry matter intake of Friesian heifers calving at high (*) or low (o) liveweight and Jersey heifers calving at high (■) or low (□) liveweight. SED values between all treatment groups are shown above the X axis.



DISCUSSION

Milk production responses to increased condition at calving have been variable in cows fed total mixed ration diets, but in studies where pasture formed the basal diet, greater condition at calving has consistently led to increased milk production (Rogers *et al.* 1979; Grainger *et al.* 1982). In the current experiment, actual milk yields of L heifers compared to H heifers were significantly reduced across the whole lactation. This was primarily due to the lower yields of Jerseys, and to a lesser extent Friesians, over the first 56 days of lactation (Figure 2). Rogers *et al.* (1979) and Grainger *et al.* (1982) both reported that improved condition at calving increased milk production in early lactation by causing a more favourable partitioning of energy into milk at the expense of liveweight gain. The results of the current study support this theory, with H heifers losing liveweight during early lactation (Figure 1), despite the generous pasture allowances, but producing more milk during this period than L heifers. Nevertheless, by 200 days since calving, the H and L heifers of each breed had similar liveweights. Further, the differences in average SCM for the season were not significant. This fact, together with the observation that concentrations of milk solids were higher for L than H heifers (Table 1), suggests that the expense of obtaining the extra liveweight at calving may not be economically justified, so long as acceptable conception rates are achieved.

There was no significant difference in the average daily milkfat and protein yields of H and L heifers across the whole lactation (Table 1). Conversely, low calving liveweight increased lactation averages of milkfat and protein concentrations, possibly due in part to reduced milk volumes. These results are contrary to previous reports that low pre-calving nutrition of pasture-fed cows reduced milkfat concentration (Hutton and Parker, 1973; Rogers *et al.* 1979; Grainger *et al.* 1982).

Previous researchers have shown that greater cow condition at calving can result in reduced DMI of pasture diets (Grainger *et al.* 1982). In the current experiment,

however, DMI were considered quite low for all groups, and neither full lactation DMI, nor liveweight-corrected DMI values were affected by calving liveweight (Table 1). This may be because the animals used were heifers which even when in good condition at calving still required nutrients for growth. There were significant effects of calving liveweight on absolute DMI at approximately 215 days since calving, at which time DMI was higher for L than H heifers; this suggests that L heifers may not compensate by increasing DMI until mid-lactation. Further investigations are required to determine if this is the case.

In conclusion, the results of the current study support the observations of previous researchers that greater condition at calving results in increased milk production in early lactation and for the season. In this connection, Jerseys appeared to be affected to a greater extent by low calving liveweight than Friesians. SCM of the L group approximated those of the H group by between 50 and 100 days since calving, however, and there was no difference between the two groups over the season. These data therefore raise questions as to the value of the extra liveweight at calving. Contrary to most published literature, L heifers did not consume more dry matter through early lactation, or for the lactation as a whole; despite this liveweights of the two groups were approximately equal by the end of lactation.

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