Precalving nutrition of heavy two year old Angus heifers weighing 415 kg at calving

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ABSTRACT

When they were weaned at five and a half months of age, 33 Angus heifers were randomly divided into two groups representing different planes of nutrition. From weaning until two months before calving which began on 15 July 1977 the liveweight difference between the two groups was steadily increased until the high plane group (HP) weighed 17 kg more than the low plane group (LP) on 17 May 1977. From then until calving the high plane group was fed to maintain constant liveweight, while the low plane group was fed to gain liveweight at the rate of 0.3 kg/day. When calving began both groups weighed the same average liveweight (415 kg).

Calf birth weight was affected by nutritional treatment (HP 26.2 ± 0.65; LP 28.1 ± 0.54; $P<0.05$), as was the degree of calving difficulty (HP 0%; LP 24%; $P<0.05$). Calf milk consumption, calf liveweight gain, calf weaning weight and reproductive performance of the heifer were not affected by plane of nutrition.

The regression of the post-partum anoestrous interval on calving date was -1.88 ± 0.474 days/day ($P<0.01$). All the variance in this relationship was accounted for by the covariance between post-partum anoestrus interval and the other response variables measured, suggesting that a common factor might be operating.

The results suggest that liveweight gain close to calving in well fed Angus heifers weighing in excess of 400 kg is associated with increased calving difficulty and should be avoided.

Keywords Angus heifers, two year old, calving, heavy liveweight.

INTRODUCTION

The best feeding strategy for raising heifer replacements for the beef breeding cow herd needs further work. High levels of nutrition over the first two years of life of a heifer may be detrimental to its productivity as a cow, affecting particularly the milk production potential of the animal (Barton 1970). In the trials on which this conclusion is based two effects were confounded, liveweight and liveweight change. Heifers which experienced higher liveweight gain before calving, calved at heavier liveweights.

This paper reports the results of a trial to test the effect of two different paths of liveweight change in Angus heifers calving at heavy liveweights. The trial was designed so that each group of heifers calved at the same liveweight, avoiding the problem of confounding the effect of liveweight change with liveweight.

MATERIALS AND METHODS

On March 11 1976, when the Angus calves born at Massey University's hill country farm 'Tuapaka' in the spring of 1975 were weaned, the heifer replacement calves were randomly divided into two groups. At that time the calves on average were five and a half months old.

The 16 heifers in the high plane (HP) group were grazed on pasture on the productive flat land at Tuapaka. They were fed to ensure that high rates of liveweight gain would be achieved. The 17 heifers in the low plane (LP) group were grazed on the hill pastures, and were rationed pasture to allow for a small liveweight difference to develop between them and the HP heifers.

A 10 kg difference in liveweight was attained by 11 May 1976, and this difference was maintained until February 1977. Then the liveweight difference between the two nutritional groups was steadily increased until 17 May 1977 when the HP heifers weighed 16 kg more than the LP heifers (HP 415 ± 4.5 kg; LP 398 ± 5.6 kg). From that date until calving began on 15 July 1977 the HP heifers were fed to maintain a constant liveweight, while the LP heifers were rationed pasture to gain liveweight (including conceptus) at the rate of 0.3 kg per day. On 15 July 1977 both treatment groups attained, by design, the same liveweight of 415 kg.

After 15 July 1977 both treatment groups were grazed together on the hill pasture at Tuapaka. Calving finished on 5 August 1977.

Data were collected on the production variables listed in Table 1. The milk consumption of the calves was estimated using the weigh-nurse-weigh method, following a 16 hour separation of the cow and calf (Barton 1970), all measured on the same date. The time (days) to first post - partum oestrus was observed each day using the technique of tail painting the cows (MacMillan and Curnow, 1977). Calving difficulty was deemed to occur when a cow needed assistance at calving, or when a large calf was born dead.

Statistical Methods

The analysis considered 5 response variables, namely, calf birth weight, calf milk consumption, calf liveweight at 60 days of age, calf weaning weight at 190 days of age and the post - partum anoestrous interval of the dams. These variables were correlated, so a multivariate analysis of variances was used (Morrison, 1990). The control variables were the two nutritional treatments, calf, sex, and a covariate on calf birth dates.

The test of the null hypothesis for all linear combinations of the response variables was carried out using Wilks lambda statistic (Chatfield and Collins, 1980). Rao's Test was used to decide

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whether a single response variable found to be significant for some control variable showed significance independently of the covariance of this response variable with other response variables with other response variables (Chatfield and Collins, 1980).

Discrete data on calving difficulty were analysed using the Chi-square test.

Precalving management of the nutritional groups had two components. A gradual separation of the mean liveweights of the two groups until 17 May 1977, followed by the management described for the two months before calving commenced. To estimate the relative contribution of each period to the response variables, linear regressions were fitted to the liveweights of each heifer measured from their weaning on 11 March 1976 to 17 May 1977. Quadratic regressions were fitted to the heifer liveweights from 17 May to 15 July when calving began. The regression coefficients were then entered as within treatment covariates to the statistical model, following the analysis for growth curves described by Grizzle and Allen (1969).

RESULTS

The least squares means for the nutritional treatments are given in Table 1. Wilks test showed the treatment differences to be highly significant (P<0.01). However, only calf birth weight showed a significant response to nutritional treatment independently of the other response variables (Rao's Test). Calves from the LP group were 1.9 kg heavier than calves from the HP group (P<0.05). A result associated with calf birth weight was that only the LP heifers experienced calving difficulty, with 4 cases or a 24% incidence (P<0.005).

TABLE 1 Least squares means and standard errors of the response variables for each nutritional treatment.

Response variable	Plane of nutrition	
	High plane	Low plane
Calf birth weight (kg)	26.2 ± 0.65	28.1 ± 0.54
Milk weight (40 days) (kg)	4.7 ± 0.37	4.3 ± 0.31
Calf liveweight (60 days) (kg)	67.1 ± 1.81	69.5 ± 1.51
Calf weaning weight (kg)	205.6 ± 5.47	203.8 ± 4.59
Post-partum anoestrous interval (days)	110.5 ± 5.20	102.4 ± 4.30
Number of cases (and percent)	0 (0)	4 (24)

All differences P<0.01.

Dam liveweight on average was the same for each nutritional group before calving began. However, when measured at an average of 40 days after calving the heifers that had been in the LP group weighed 8 kg less than the heifers of the HP group (HP 350±8.5 kg; LP 342±8.0 kg). The large variance was associated with this difference made the liveweights indistinguishable.

There was no significant difference between the birth weight of male (M) and female (F) calves (M 27.5 ± 0.67 kg; F 26.8 ± 0.51 kg), however, all cases of calving difficulty involved male calves, demonstrating an effect of calf sex on this response (P<0.06). At weaning male calves were significantly (P<0.01) heavier than female calves (M 215 ± 5.7 kg; F 195 ± 4.3 kg).

The regression coefficients for the response variables on calving date are given in Table 2. Highly significant (P<0.01) regression coefficients were calculated for calf birth weight, calf liveweight at 60 days of age, and days to first post-partum oestrus. However, only the regression for calf birth weight remained significant after the covariance with other response variables had been taken into account.

TABLE 2 Linear regression coefficients and standard errors for the regression of the response variables on calving date.

Response variable	Regression coefficient
Calf birth weight (kg/day)	0.18 ± 0.059**
Milk weight (kg/day)	No relationship
Calf livewt at 60 days (kg/day)	-0.45 ± 0.165**
Calf weaning weight (kg/day)	-0.68 ± 0.051**
Post-partum anoestrous interval (days/day)	-1.88 ± 0.474**

** P<0.01

There was no difference between the heifers that was attributable to their previous nutritional treatment for mean calving date, or calving percentage of these females in their second production year (1978).

Only the linear regression coefficients for the liveweight change from 17 May 1977 to 15 July 1977 for the HP treatment on calf birth weight was significant (0.35 ± 0.03 kg per kg; P<0.025). Since by design all LP heifers were gaining weight over this period, this suggests that the observed difference in calf birth weights due to the nutritional treatments was the result of first order, or linear, liveweight gain in the period immediately before calving.

DISCUSSION

These heifers weighed 415 kg at calving. In contrast Nicoll *et al.* (1984) reported essentially the same level of production as that measured here with heifers weighing 360 kg at calving, suggesting that raising heifers to calve at the heavy weights attained in this experiment is inefficient.

There were two variables found to be affected by liveweight gain close to calving. These were calf birth weight, and the degree of calving difficulty in the birth of male calves, liveweight gain at this time increasing both variables in these heifers. This effect was not found in mature cows experiencing different paths of liveweight change before calving, but calving at the same liveweight (Pleasants and Barton, 1985). Nicoll *et al.* (1984) found similar rates of calving assistance were required for heifers calving at mean liveweights of 400 kg or 381 kg, and experiencing 0.6 to 0.7 kg per day liveweight gain before calving, supporting our hypothesis that liveweight per se is less important than liveweight combined with liveweight gain. That is, pre-calving liveweight gain in a herd of heavy (400 kg) Angus heifers increases the likelihood of calving difficulty.

The time to first post-partum oestrus is very long (106 days), and the very high regression coefficient of this response variable on calving date (-1.88 days per day). The high standard error on this variable suggests the influence of outliers, though none could be objectively identified. No significant variation existed for this relationship independently of the covariance with other response variables. This is interpreted to mean that whatever the cause of the linear relationship between the post-partum anoestrous period and calving date, there was no evidence to suggest that it was fundamentally different from the cause of the linear relationships between the other dependent variables and calving date.

This work has relevance to the 'Once-Bred Heifer' farming system described by Morris *et al.* (1991) and Inwood *et al.* (1992), though dairy cross rather than Angus heifers are the preferred breed in this case. There has been conflict in managing

these heifers to achieve good slaughter weights at 30 months of age, while avoiding calving difficulty (Morris and Khadem 1991). This study suggests that avoiding liveweight gain eight weeks before calving would help to avoid calving difficulty, but also that liveweight gain over this period tends to be absorbed by foetal and maternal fluids and membranes, and does not contribute to the liveweight of the heifer. The absorption of liveweight gain close to calving into foetal fluids and membranes was also observed in mature cows by Pleasants and Barton (1985). Thus there is no advantage, and some disadvantage in liveweight gain over this period in a Once-Bred Heifer system.

In summary gaining liveweight over the period two months before calving influences the performance of two-year-old first calving Angus heifers. If they are heavy (>400 kg) at this time, liveweight gain may cause calving difficulty, and will not improve productivity. It seems best avoided.

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