EFFECT OF FORMALDEHYDE-TREATED CASEIN ON OESTROUS ACTIVITY AND MILK PRODUCTION IN ANGUS HEIFERS

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SUMMARY

Angus heifers supplemented with 500 g formaldehyde-treated casein (FTC), during the second and third months of lactation, lost slightly less weight but came into oestrus 17 days later than unsupplemented heifers. Calves from supplemented heifers grew faster, despite a slightly lower milk intake. The milk production of unsupplemented heifers was significantly higher when expressed in relation to heifer live weight. Milk fatty acid analyses showed that unsupplemented heifers were drawing more heavily on body reserves of fat for milk fat synthesis. .

INTRODUCTION

Prolonged anoestrus after calving, and the consequent failure to produce a calf per year, can be a serious cause of inefficiency in beef production, especially in first-calf heifers (Tervit *et al.* 1977). Recently, Axelsen (1980) reported an earlier onset of oestrus in first-calf Angus heifers supplemented with whole lupin grain. However, due to uncertainty about the fate of lupin protein in the rumen, this response cannot be categorically attributed to increased protein supply. In the present study, we examined the effect of supplements of formaldehyde-treated casein (FTC) on the onset of oestrus and the level of milk production in Angus heifers. Calf performance was also measured and milk samples were analysed for fatty acid composition, since this has proven to be a sensitive indicator of nutritional status in lactating beef animals (Stobbs and Brett 1976; Payne *et al.* 1979).

MATERIALS AND METHODS

Animals and diets

The experiment was conducted at Ginninderra Experiment Station, near Canberra in autumn 1978. Thirty-six two-year-old Angus heifers were randomised on the basis of post-calving live weight into two treatment groups, hereafter referred to as "Casein" and "Control" heifers. Approximately one week after calving, animals were moved to concrete pens (three heifers and their calves per pen) with individual feeding facilities. Each heifer was offered a daily ration of 4.5 kg oat grain (1.7% N) and 2.0 kg of medium quality wheaten hay (1.2% N). Dietary treatments were imposed 30 days after calving. All heifers then received 2.0 kg oat grain and 2.1 kg of the above hay. In addition, Casein heifers received 2.0 kg of pellets consisting of 1.5 kg of crushed wheat (2.3% N) plus 0.5 kg FTC. Control heifers received 2.1 kg of crushed (unpelleted) wheat to provide the same metabolizable energy as the 1.5 kg of crushed wheat and 0.5 kg of FTC. Pellets . and crushed wheat were offered first to ensure their consumption. Feeding continued until 90 days after calving, after which heifers and calves returned to pasture. Heifers had access to water at all times, but calves were denied access to water and solid food.

Measurements

Heifers in pens were observed closely every day. The criterion used to

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define oestrus was standing for mounting by the other heifers in the pen (see Plasto and Hall 1970). An entire Angus bull was then allowed access to the pen, and oestrus confirmed in terms of mounting and service by the bull. This occurred on every occasion oestrus was observed. After heifers had returned to pasture oestrus was detected using an entire Angus bull fitted with a chin-ball harness.

Heifers and calves were weighed weekly before feeding. The milk intake of 18 calves (nine in each treatment group) was estimated weekly using a tritiated water dilution method as described by Dove and Axelsen (1979). At these times, milk samples were obtained from the 18 dams for subsequent analysis of milk fatty acids.

Assessment of formaldehyde-treated casein (FTC)

The casein was treated in a single batch, by mixing with 1.12% of its weight of added formalin for 20 minutes. The efficacy of protection was assessed by incubating samples of the crushed wheat or crushed pellets in dacron bags, in the rumens of four sheep, for periods of 1.0 to 8.5 hours. Results indicated that over 8.5 h, no more than 6% of casein-N was lost. In addition, the digestibility of casein-N was measured in six sheep fed pelleted diets of either lucerne or lucerne plus FTC. Results showed that 75% of casein-N was apparently digestible. This suggests that the FTC was not over-protected (J.P. Hogan, personal communication).

Milk fatty acid analyses

Milk samples were bulked within treatment for each week of lactation. Fat was extracted using 10 volumes of heptane and the extracts butylated (Parodi 1970). The butyl esters were analysed by gas chromatography on a 1.85 m column packed with 15% EGSS-X on Gas-Chrom Q. Analyses were conducted isothermally at 185° on a Varian 3700 gas chromatograph with flame ionization detection.

Statistical analyses

All data were analysed by analysis of variance. Post-calving intervals to oestrus or conception were transformed to reciprocals prior to analysis. Where appropriate, the data were adj'usted by covariance for differences in the initial live weight of heifers or calves. One calf performed much worse than the other 35 calves, and its results were excluded from the analyses.

RESULTS

Heifer live weights

From a mean post-calving weight of 342 kg (SE ± 4 kg), all heifers lost weight during the preliminary period so that when dietary treatments started, Casein heifers weighed 318 ± 6 kg and Control heifers weighed 325 ± 5 kg. In the sub-group of 18 heifers which were milked, Control heifers lost 13 kg live weight over the 60 day feeding period, while Casein heifers lost only 2 kg ($P = 0.0007$). However when all 36 heifers were considered, the losses were 17 kg and 9 kg respectively ($P = 0.104$). After returning to the field, where pasture conditions were poor, Control and Casein heifers gained weight at 0.24 and 0.26 kg/day respectively.

Reproductive activity

Of the 36 heifers, 17 on each treatment experienced oestrus and 16 on each treatment finally conceived. Oestrus in Control heifers occurred earlier ($P = 0.060$) at 71.4 days after calving, (standard errors +5.7 and -4.9 days). The equivalent time for Casein heifers was 88.6 days (S.E. +7.4 and -6.4 days). Live weights at first oestrus were 309 ± 4 kg and 308 ± 6 kg for Control and Casein heifers respectively. A regression analysis showed that the interval to first oestrus was not affected by calving date ($r = 0.14$), weight at calving ($r = 0.01$) or mean daily milk production ($r = 0.23$). Two Casein heifers conceived at their second oestrous period. As a result the interval from calving to conception was significantly shorter ($P = 0.016$) in Control heifers (69.0, +5.2, -4.5 days) than in Casein heifers (91.1, +7.7, -6.6 days).

Milk fatty acid composition

Dietary treatment did not influence the proportions of short to medium chain fatty acids (C4:0 to C16:0) in milk fat which, over all. weeks, were 52.6 ± 0.7% and 52.2 ± 0.8% for Control and Casein heifers respectively. However the ratio of oleic acid (C18:1) to decanoic acid (C10:0) in milk fat, which appears to be a more sensitive indicator of tissue fat mobilization (Payne *et al.* 1979), was significantly higher ($P = 0.004$) in Control heifers (13.3 ± 0.5) than in Casein heifers (10.4 ± 0.5) over the feeding period. Both ratios are indicative of tissue fat mobilization (Payne et *al.* 1979) which appears greater in Control heifers.

Calf milk intake and liveweight gain

Since calves were denied access to solid food and water, their measured daily water turnovers can be regarded as estimates of milk intake (Dove and Axelsen 1979). Table 1 shows estimated milk intakes, so defined, together with mean liveweight gains. Calves from Control heifers consistently consumed slightly but not significantly more milk ($P = 0.134$). Milk intakes expressed in relation to heifer live weight to the power 0.70 can be used as a measure of milk production (Macfarlane *et al.* 1969). Stated in these terms (Table 1) the milk production of Control heifers was significantly higher ($P = 0.006$).

TABLE 1 Influence of formaldehyde-treated casein on calf milk intake, heifer milk production and calf liveweight gain

	Control	Casein	Standard error of the difference
Milk intake (l/d)	6.87	6.57	0.20
Milk production (ml/kg$^{0.7}$/d)	128.0	118.2	3.5
Liveweight gain (g/d)	440	487	36
Liveweight gain (g/l/d)	62.7	72.9	4.6

Over the 60 day feeding period, calves from Control and Casein heifers grew at 400 and 450g/d respectively. A similar result is obvious (Table 1) for the 18 calves in which milk intake was measured. Liveweight gains (g/d) were not significantly different ($P = 0.188$) but when these were expressed inrelation to milk intake (Table 1) it was apparent that Casein calves grew significantly faster ($P = 0.029$).

DISCUSSION

The initiation of oestrus in beef cattle after calving is a complex process influenced by age, breed, calving date, weight or condition at calving, pre- and post-calving nutrition, the degree of suckling stimulus and the level of milk production (see review by Tervit *et al.* 1977).

In the present study, the intervals to first oestrus were close to those observed in beef heifers by other workers (e.g. Holness *et al.* 1978; Axelsen 1980). The unexpected result was the apparent delayed onset of oestrus in heifers given FTC, which occurred despite the fact that these lost slightly less weight and produced less milk. Such a result is difficult to interpret in relation to the factors said to influence post-calving anoestrus. Live weights at calving were nearly identical in the two groups, and did not influence the results when used as a covariate. Similarly, calving date had no effect on the onset of oestrus, perhaps because calving was in autumn (Tervit *et al.* 1977). The response does not seem to be related to energy intake, which was approximately the same for the two treatments. Moreover, our evidence suggests the FTC was neither under- nor over-protected. To our knowledge, the results of Holness *et al.* (1978) are the only comparable results to ours, for in their study, cows which lost live weight from calving to oestrus came into oestrus about 20 days earlier than cows which gained live weight. This is similar to the slightly greater weight loss and earlier onset of oestrus in Control heifers.

One interesting aspect of the results was that Casein calves grew significantly faster per litre of milk intake, despite a slightly lower milk intake. This suggests an effect of treatment on milk protein and/or energy levels, an aspect we are currently evaluating further.

In conclusion, our results provide little evidence that low protein intakes during lactation delay the onset of oestrus in beef heifers, or that the response of such animals to lupin supplementation (Axelsen 1980) is a response to increased protein supply.

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