PUBERTY AND BREEDING PERFORMANCE OF BEEF HEIFERS DEVELOPED AT DIFFERENT RATES OF GAIN

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Summary

Crossbred heifers (546 lb initial body weight) were developed in drylot and limit-fed a corn, corn silage diet to gain .5 (n = 14), 1.0 (n = 15), 1.5 (n = 14), or 2.0 lb/d (n = 15) from Dec. 7, 1992 until the onset of the breeding season, May 3, 1993. Actual daily gains averaged 1.0, 1.4, 1.8, and 2.1 lb/d, respectively. Age at puberty was not affected by feeding treatment. At the onset of the breeding season, nutritional treatment had a linear effect on body condition score, ribeye fat thickness (both P<.01), and reproductive tract score (P<.05), all increasing with increasing rate of gain. Nutritional treatment had a quadratic effect on pelvic area (P<.05), which averaged 190.6, 201.6, 206.5, and 205.3 cm^2 for heifers fed to gain .5, 1.0, 1.5, and 2.0 lb/d, respectively. At the conclusion of the development period, estrus was synchronized, and heifers were inseminated artificially at estrus for 45 days and, if open, mated naturally for another 17 d. Overall pregnancy rates were similar among heifers fed to gain .5, 1.0, and 1.5 lb/d (92.9, 93.3, and 92.9%, respectively), and all tended to be greater (P<.09) than the rate for heifers fed to gain 2.0 lb/d (66.7%). In summary, NRC recommendations underestimated gain of limit-fed heifers at lower predicted rates of gain. Thus, even though heifers fed to gain only .5 lb/d had lower body condition scores and reproductive tract scores at the onset of the breeding season, their actual body weight gains (1.0 lb/d) were sufficient for normal onset of puberty and subsequent conception. In addition, heifers fed to achieve relatively high rates of gain (2.0 lb/d) during development may have had impaired fertility.

(Key Words: Beef Heifers, Puberty, Heifer Development.)

Introduction

Numerous reports indicate that yearling beef heifers that are managed to conceive early in the breeding season have greater lifetime productivity than heifers that conceive later. To increase the likelihood that heifers will conceive early, they must have attained adequate age and body weight to be cycling before the start of the breeding season.

A popular rule of thumb is that heifers should be fed to attain 60 to 65% of their estimated mature body weight by the start of the breeding season. Although severe nutrient restriction during development delays puberty, information is limited regarding reproductive performance of heifers developed to body weights somewhat below 65% of mature weight. If reproductive performance remained normal, developing heifers to lower prebreeding target weights could lower feed costs and reduce the potential for overconditioning, especially in smaller-framed heifers.

Our primary objective was to evaluate age at puberty and breeding performance of heifers developed at different rates of gain. Treatments were designed to have heifers weighing 55 to 75% of their expected mature body weight by the onset of the breeding season.

Experimental Procedures

Angus × Hereford heifers were blocked by weight and assigned randomly within weight blocks to four treatments. Treatments were designed to produce body weight gains of .5 (n = 14), 1.0 (n = 15), 1.5 (n = 14), and 2.0 (n = 15) lb/d. Heifers were housed three or four per pen, with four pens per treatment. Diets were formulated according to NRC (1984) recommendations to achieve the desired rates of gain; the diet (as fed) was 70% corn silage, 30% corn, and 3% of a vitamin-mineral supplement that supplied Rumensin® at 150 mg/hd/d. Enough soybean meal was topdressed daily to supply protein requirements for the desired gains. The feeding period began on Dec. 7, 1992 and continued to May 3, 1993. Body weights, without shrink, were obtained every 14 d.

Beginning on Feb. 15, serum samples were obtained on Monday, Wednesday, and Friday and analyzed for progesterone. Two consecutive samples with progesterone concentrations above 1 ng/ml indicated ovulation and luteal function; age at puberty was defined as age at the sampling date immediately prior to the progesterone increase. Weight at puberty was the body weight closest to the age at puberty. The measured body weight was reduced by 4% to account for fill.

Body weight; body condition score (1 = extremely thin, 9 = extremely fat); ribeye fat thickness; pelvic area; and reproductive tract score (1 = infantile uterus, 5 = mature, cycling, corpus luteum present) were determined at the conclusion of the feeding period. Then estrus was synchronized by two injections of Lutalyse®, with the final injection on May 5. Heifers were inseminated artificially at estrus using the AM-PM rule for the first 45 days. Then clean-up bulls were used for 17 days. Pregnancy was verified by ultrasonic evaluation of the uterus 36 days after the end of the breeding period.

Fasting heat production was calculated retrospectively from the performance of the heifers, utilizing NRC (1984) net energy equations.

Results and Discussion

The performance and reproductive characteristics of heifers fed to gain .5, 1.0, 1.5, and 2.0 lb/d during development are illustrated in Table 1. Daily gains exceeded NRC-predicted daily gains. This overperfomance was generally greater at lower predicted rates of gain, which suggests that the performance predicted by the NRC becomes increasingly inaccurate as calculated gains are < 2 lb daily. This phenomenon may be explained, in part, by the reduced maintenance energy requirements of limited-fed cattle as reflected by reduced estimates of fasting heat production (Table 1).

The major objective of this study was to evaluate reproductive performance of heifers entering the breeding season below the currently recommended 60 to 65% of their expected mature body weight. Because our heifers gained faster than anticipated, even heifers on the most restricted diet entered the breeding season at approximately 63% of their expected 1100 lb mature body weight. Calculated percentages of mature body weight were 68%, 75%, and 78% for heifers fed to gain 1.0, 1.5, and 2.0 lb/d, respectively.

Age and weight at puberty were similar across treatments. However, body condition scores, ribeye fat thickness ($P<.01$), and reproductive tract scores ($P<.05$) all increased linearly in response to increased rates of gain. There was a quadratic response to treatment for pelvic area, which increased for heifers fed to gain between .5 to 1.5 lb per day but remained similar for heifers with predicted gains of 1.5 and 2.0 lb/d.

By the onset of breeding, only one heifer (.5 lb/d treatment) was not pubertal, as estimated by serum progesterone. Thus, even though heifers on this treatment had lower reproductive tract scores, all treatments, on average, had reproductive tract scores of 4 or greater, indicative of cyclicity. Based upon

our estimates of pubertal onset and reproductive tract scores, all heifers were developed sufficiently to enter the breeding season. However, heifers in the 1.0, 1.5, and 2.0 lb/d gain treatments, although reproductively competent, had increased body condition scores and ribeye fat thickness, indicating that they may have been fatter than desirable. This degree of overconditioning may have depressed the fertility of heifers fed to gain 2 lb/d, as evidenced by their tendency (P<.09) for reduced pregnancy rates.

Our data suggest that NRC net energy equations underestimate the performance of cattle at very low rates of gain. Although heifers fed to gain .5 lb/d had reduced body condition scores and reproductive tract scores, their body weight gains were sufficient to attain normal puberty and conception. In addition, overconditioning may impair fertility of heifers.

Table 1. Performance and Reproductive Characteristics of Heifers Developed at Different Rates of Gain

	Predicted Daily Gain, lb				
Item	.5	1.0	1.5	2.0	SE
No. of heifers	14	15	15	15	-
Initial wt., lb	547	544	550	545	19
Prebreeding wt., lb [a]	692	754	823	855	23
Daily gain, lb [a]	1.0	1.4	1.8	2.1	.08
Fasting heat production, kcal/kg $BW^{.75}$ [b]	62.7	66.8	66.1	84.1	4.8
Age at puberty, d [c]	386.6	374.1	373.6	385.6	9.8
Weight at puberty, lb	655	689	732	764	27
Body condition score [d]	5.7	6.1	6.6	6.8	.1
Fat thickness, in [a]	.25	.25	.39	.47	.03
Pelvic area, cm^2 [e]	190.6	201.6	206.5	205.2	2.7
Reproductive tract score [f]	4.0	4.2	4.5	4.5	.2
Pregnancy rate, % [g]	92.9	93.3	92.9	66.7	-

[a]Linear effect of treatment (P<.01).
[b]Linear effect of treatment (P<.05).
[c]Sampling period immediately preceding two consecutive measures of serum progesterone greater than 1 ng/ml.
[d]Linear effect of treatment (P<.01); 1 = extremely thin, 9 = extremely fat.
[e]Quadratic effect of treatment (P<.05).
[f]Linear effect of treatment (P<.05). Scale of 1 to 5; 1 = infantile, prepubertal, 4 = cycling, but no corpus luteum present, 5 = cycling, but corpus luteum present.
[g]Estimated ultrasonographically 36 d after the conclusion of the breeding period; lower for heifers fed to gain 2.0 lb/d (P<.09).