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NUTRITIONALLY-DIRECTED, COMPENSATORY GROWTH REGIMEN IN BEEF HEIFER DEVELOPMENT

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Research Summary

Appropriately designed growth regimens prior to first parturition can affect mammary development, subsequent lactational performance and feed efficiencies. The objective of this study is to determine the effect on growth performance and lactational potential of beef heifers reared on a stair-stepped nutritional program imposed during the pubertal phase. Average daily gain (ADG), body condition score (BCS) and growth efficiency (GE, gain/feed) were reduced during the energy restricted phase of the stair-step regimen. Conversely, ADG, BCS and GE were improved by stair-step regimen during the high energy phase. Dry matter intake was also increased in the stair-step regimen during the later phase. Over the entire feeding period, ADG and DMI were not affected by dietary regime. However, GE and total heifers conceiving during the breeding season were improved by the experimental regimen. These results indicate that beef heifers raised on a stair-step nutrition and feeding regimen during puberty display compensatory responses in growth efficiency.

Introduction

Rapid prepubertal growth due to a high plane of nutrition has been shown to reduce subsequent milk production in

beef and dairy heifers. Thus, beef producers are annually faced with the dilemma of pushing replacement heifers to achieve optimal body weights prior to the breeding season so that they will calve early in their first calving season while not potentially reducing subsequent lactational performance. Several researchers have shown that nutritional regimens which impose a period of growth restriction followed by a period of growth compensation have minimal to no delay in the onset of puberty and as much or more milk produced during their first lactation compared to heifers maintained at a continuous rate of gain prior to breeding (Carstens et al., 1997). Park et al. (1998) at the Central Grasslands Research Center in Streeter demonstrated that milk production potential could be enhanced in beef heifers developed under such a stair-stepped growth regimen. A study was initiated at the Dickinson Research Extension Center to follow-up on the results seen at CGRC and to refine the stair-step approach in beef production systems. The objective of this study is to determine the effect on growth performance and lactational potential of beef heifers reared on a stair-stepped nutritional program imposed during the pubertal phase.

Materials and Methods

Ninety-six heifer calves were blocked into three weight groups and randomly assigned to twelve feedlot pens within group (8 heifers/pen; 6 pens/group). Pens within group were then assigned one of two dietary regimens (2 pens/treatment/group). Dietary regimens represented heifers nutritionally managed for a continuous rate of gain (1.5 lb/d) for 20 wk (CONT) or for a minimal rate of gain for 10 wk followed by a rapid rate of gain for 10 wk (SSCN). The minimal rate of gain was imposed by energy restriction. Metabolizable energy concentration (ME) of the restricted diet was similar to diet used in CONT, however dry matter intake (DMI) was restricted to 60% of DMI of CONT heifers. Protein concentration (CP) was increased in the restricted diet to allow for similar daily intakes between dietary regimens. Following the restricted gain phase, SSCN heifers were given ad libitum access to a high energy diet (130% ME and 100% CP of CONT diet) for 10 wk. Subsequently, all heifers were managed as CONT through breeding. Diets used in the restricted and compensating phases study are shown in table 1.

Diets were mixed and fed daily. Intake of SSCN heifers during the restricted phase was paired to CONT heifers daily within weight group. "Minimal feed refusal" bunk management was employed in CONT heifers to accommodate calculation of 60% DMI level. Body weight (BW) and body condition score (BCS) was recorded every 14 d. Estrus was synchronized and heifers were artificially inseminated 12 hr following standing heat. Heifers were then exposed to bulls for the remainder of the breeding season.

Data were analyzed as a randomized complete block design using standard analysis of variance procedures.

Results and Discussion

Initial BW (P=.09) was greater in SSCN heifers, while BCS (P=.23) did not differ between dietary regimen (table 2). During the restricted phase (first 10 wk), final BW (P=.04), BCS (P=.03), average daily gain (ADG; P=.04), DMI (P=.01) and gain efficiency (GE; P=.08) were all depressed by SSCN. During the compensating phase (final 10 wk), final BW (P=.12) did not differ between dietary regimen. Body condition score (P=.03), ADG (P=.01), DMI (P=.01) and GE (P=.01) were all increased by SSCN. There were no difference due to dietary regimen in overall (20 wk) ADG (P=.16) or DMI (P=.14), however GE (P=.07) and breeding season conception rates (P<.1) were improved 23 and 15%, respectively.

In an earlier study (Poland et al., 1998), heifers developed under a more intensive stair-step regimen had higher final BW and ADG compared to heifers managed for constant rates of gain. Overall, feed efficiency and breeding performance were also numerically improved in the heifers in the stair-step regimen.

These results suggest that it is possible to implement a stair-step nutritional regimen in practical beef production systems. Growth of heifers developed under this system can be limited using intake restriction. Heifers provided ad libitum intakes of a high energy diet following growth restriction experience compensatory responses in growth and gain efficiency. Reproductive performance is not depressed by the implementation of a prepuberal stair-step regimen. Weaning weights of calves born to these heifers will monitored to assess whether the stair-step regimen influenced effective milk production.

Literature cited

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Table 1. Diet composition (as fed basis) during Stair-Step heifer development study at DREC 1998[a].

	Control	Stair-Step
Restricted Phase (70d)		
Corn silage	77.8	29.4
Alfalfa hay (ground)	14.2	58.5
Corn grain (rolled)	7.6	4.7
Soybean oil meal	--	6.4
Sunflowers (whole)	--	--
White salt	.14	.32
ADE premix	.28	
Compensating Phase (70d)		
Corn silage	77.1	26.4
Alfalfa hay (ground)	14.5	12.0
Corn grain (rolled)	7.8	52.3
Soybean oil meal	--	--
Sunflowers (whole)	--	8.5

White salt	.16	.22
ADE premix	.02	.03
Urea	--	.10
MGA, supplement	406. lbs	406. lbs

Table 2. Animal performance of heifers on Stair-Step heifer development study at DREC 1998[a].

	Control	Stair-Step	P-value
Initial conditions			
BW, lbs	625.1	631.1	.09
Condition score[b]	6.2	6.3	.23
Restricted Phase (70d)			
BW, lbs	711.9	641.8	.04
Condition score	6.0	5.2	.03
ADG[c], lbs/d	1.24	0.15	.04
DMI[c], lbs/d	14.8	9.4	.01
Growth Efficiency[c]	8.4	1.7	.08
Compensating Phase (70d)			
BW, lbs	841.8	884.7	.12

Condition score	6.2	6.7	.03
ADG, lbs/d	1.86	3.47	.01
DMI, lbs/d	16.4	20.1	.01
Growth Efficiency	11.4	17.3	.01
Overall Performance (140d)			
ADG, lbs/d	1.55	1.81	.16
DMI, lbs/d	15.6	14.7	.14
Growth Efficiency	10.0	12.3	.07
Conception rate over breeding season, %	75.0	89.6	-[d]

[a]Data considered preliminary, full statistical analysis is pending.
[b]Body condition score (9 point scale; 1=emaciated, 9=obese).
[c]ADG = average daily gain; DMI = average daily dry matter intake; Growth efficiency (gross) = ADG/DMI*100.
[d] Not applicable.

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