GROWTH RATE OF BEEF HEIFERS
I. BODY COMPOSITION AT PUBERTY

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Story in Brief

Thirty-eight Angus x Hereford heifers were blocked by body weight and age to three nutritional regimes to evaluate the effect of growth rate on body composition at puberty: 1) full fed to gain 3.0 lb/day; 2) limit fed to gain 1.5 lb/day; 3) maintenance-full fed to gain .4 lb/day for 16 weeks then full fed to gain 3.0 lb/day. Progesterone in plasma was quantified weekly to determine the onset of puberty (luteal activity). Heifers were slaughtered within 10 days after puberty. Total body fat was determined in five categories: 1) omental-mesenteric, 2) udder, 3) kidney-pelvic-heart, 4) subcutaneous and 5) intermuscular. At puberty, full fed animals had greater body weights, greater body condition scores and more total body fat (as a proportion of carcass weight) than either the limit or maintenance-full fed animals. We conclude that carcass composition, body weight and body condition score at puberty can be altered by rate of gain, and body energy reserves alone do not regulate puberty in beef heifers.

(Key Words: Beef Heifer, Body Fat, Carcass, Progesterone, Puberty.)

Introduction

Improvements in reproductive efficiency could greatly increase the profitability of beef production. Bellows et al. (1979) estimated that less than 75% of postpartum cows and replacement heifers exposed to bulls, became pregnant during the breeding season and calved the following year. Of nonpregnant animals, postpartum cows remained anestrus while heifers failed to reach puberty during the breeding season. Therefore, feeding programs that enhance adequate growth and development of replacement heifers could greatly increase both the biological and economic efficiency of production.

Although most producers set a target age at puberty of 12 to 16 months, age is not the only factor affecting puberty. Factors such as breed, weight and

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body condition or body energy reserves may influence when the first estrus occurs. Body energy reserves influence reproductive performance in postpartum cows; therefore, body energy reserves could regulate the onset of puberty. Wagner et al. (1988) indicated that total fat in the carcass of beef cows could be accurately estimated by using a body condition scoring (BCS) system of 1 to 9. Steers fed diets to achieve greater daily gains had increased fat in their carcasses (Waldman et al., 1971). Consequently, alterations in growth rate may influence carcass composition which, in turn, could affect age and/or weight at puberty.

The objectives of this experiment were to determine the effect of growth rate of heifers on carcass composition, age and weight at puberty.

Materials and Methods

Thirty-eight Angus x Hereford heifers were blocked by weight and age to three treatments. Treatments were: 1) full fed to gain 3.0 lb/day (n=13); 2) limit fed to gain 1.5 lb/day (n=12); 3) maintenance-full fed to gain .4 lb/day for 16 weeks, then full fed to gain 3.0 lb/day (n=13). Heifers were weighed and BCS was recorded every 28 days after a 16 hour withdrawal of feed and water.

Progesterone in plasma was quantified weekly to determine onset of luteal activity. Progesterone concentrations greater than 1 ng/ml for two consecutive weeks were the criterion for the onset of puberty. Date of the first of the consecutive samples greater than 1 ng/ml was considered age at puberty. Heifers were slaughtered within 10 days after the second progesterone sample greater than 1 ng/ml.

Omental-mesenteric (OM), kidney-pelvic-heart (KPH) and udder fat were physically removed from the carcasses at slaughter and carcass weight was determined. After a 48 to 72 hour chill, one side of each carcass was physically separated into lean, bone, subcutaneous fat, intermuscular fat and soft tissue. Total body fat represented the sum of OM, KPH, udder, subcutaneous and intermuscular fat; intramuscular fat was not determined in this phase of the experiment. Adjustable carcass weight was the sum of carcass weight, KPH and udder. Percentage total body fat was calculated by dividing total body fat by adjusted carcass weight + OM.

Results and Discussion

Rate of gain had a significant effect on the age and weight (Table 1) at which heifers reached puberty. Full fed heifers were younger (371 days; $P<.08$) at puberty than either the limit or maintenance-full fed heifers (412 and 405 days; respectively). Conversely, the full fed heifers were heavier (775

Table 1. Influence of rate of gain on age and weight at puberty in heifers.

Measurement	Treatment			
	Full	Limit	Maint-Full	SE
Animals, no	13	12	13	-
Age, days	371[a]	412[b]	405[b]	13
Live weight, lb	775[c]	681[d]	674[d]	62

[a,b] Values in the same row not sharing a common superscript differ ($P < .08$).
[c,d] Values in the same row not sharing a common superscript differ ($P < .05$).

lb; $P < .05$) at puberty than either the limit (681 lb) or maintenance-full (674 lb) fed heifers. Increased live weight of the full fed heifers was further reflected in their heavier adjusted carcass weights (Table 2; 491 lb; $P < .01$) compared with the limit (412 lb) and maintenance-full (394 lb) fed heifers. However, lean and bone weights of carcasses did not differ between treatments. Therefore, variation observed in carcass weight was a result of differences in fat deposition. The amounts of muscle and/or bone may have been contributing factors that influenced the onset of puberty.

Table 2. Influence of rate of gain on carcass, lean and bone weights at puberty in heifers.

Measurement	Treatment			
	Full	Limit	Maint-Full	SE
Adj carcass weight[a], lb	491[b]	412[c]	394[c]	18
Lean, lb	225	223	214	10
Bone, lb	73	73	67	2

[a] Adjusted carcass weight = carcass weight + KPH + udder.
[b,c] Values in the same row not sharing a common superscript differ ($P < .05$).

Carcass weight variation due to fat was related to differences in BCS of full fed compared to both limit and maintenance-full fed heifers (Table 3). Full fed heifers had a BCS of 6.5 ($P<.05$) at puberty compared with 5.6 for the limit fed and 5.4 for the maintenance-full fed heifers. The greater BCS of full fed heifers was related to a greater ($P<.01$) amount of total fat (156.4 lb) compared with either limit (85.2 lb) or maintenance-full (80.9 lb) fed heifers. When fat was expressed as a percentage of adjusted carcass weight, the full fed (29.4%) animals had a greater ($P<.01$) proportion of fat at puberty than the limit (19.4%) or maintenance-full (18.9%) fed animals. These results support the findings of Wagner et al. (1989) in postpartum cows indicating that BCS can be used to estimate total carcass fat in heifers. Therefore, full-fed heifers did not initiate estrous cycles when they attained similar body fat percentages (19.1%) as the limit and maintenance-full fed heifers did at puberty because they were to young.

We conclude that live weight, BCS and carcass composition at puberty in heifers can be altered by rate of gain. The variation in carcass composition is due to differences in fat deposition. Therefore, body energy reserves may not be the only factor that regulates puberty in the heifers. First ovulation may not occur until heifers attain a critical age even though they appear to be of adequate body weight and/or fat content.

Table 3. Influence of rate of gain on BCS[a] and carcass fat at puberty in heifers.

Measurement	Treatment			
	Full	Limit	Maint-Full	SE
BCS	6.5[d]	5.6[e]	5.4[e]	.2
Total fat, lb[b]	156.4[d]	85.2[e]	80.9[e]	22.3
Carcass fat (%)[c]	29.4[d]	19.4[e]	18.9[e]	1.3

[a] BCS = Body condition score (1=emaciated; 9=extremely fat).
[b] Total fat = OM + KPH + Udder + SC + SEAM.
[c] Carcass fat (%) = Total fat, lb/Adjusted carcass weight, lb + OM.
[d,e] Values in the same row not sharing a common superscript differ ($P<.05$).

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